





ORIGINAL RESEARCH

‘It’s a constant changing environment, and we’re just playing catch up’: Hospital food services, food waste, and COVID-19

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Abstract

Aims: Hospital food service operations have been affected by the COVID-19 pandemic, particularly resulting in increased waste. The aim of this research was to explore the impact of the COVID-19 pandemic on hospital food services, particularly on food waste and the completion of food waste audits.

Methods: A qualitative interview research design was used. Semi-structured interviews were completed and recorded via Zoom, focusing on the barriers and enablers towards the completion of hospital food waste audits. Twenty-one participants were interviewed from 12 hospitals. No questions were related to the COVID-19 pandemic and its impact on hospital food services, however this issue frequently emerged during interviews. Data were coded following inductive thematic analysis.

Results: Five themes were generated from the interviews related to COVID-19 and hospital food services; impacts on practice, labour, change, technology and post-pandemic expectations. Participants reported COVID-19 negatively affected food service operations. Changes included increased food waste, contact restrictions, and labour shortages. Nonetheless, hospitals embraced the challenge and created new positions, trialled different food waste data collection methods, and utilised technology to support food service operations around COVID-19 restrictions.

Conclusions: Despite the impact COVID-19 had on hospital food services, including their ability to audit food waste and increased food waste generation, the response from food services has demonstrated their adaptability to change. Sustainable healthcare, including the aggregate measuring and reduction of food waste in hospital food services, is an essential transition post-pandemic, and may be facilitated through the operational changes forced by COVID-19.

KEYWORDS

COVID-19, food, food services, hospitals, sustainability, waste

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1 | INTRODUCTION

The COVID-19 pandemic continues to have an unprecedented impact on the world's systems including transport,¹ economics, food, and healthcare.² At 16 March 2022, 460 280 168 cases and 6 050 018 deaths³ have been reported globally. Many of these individuals and their families would have interacted with the healthcare system, emphasising the stress placed on healthcare during this time of crisis. The healthcare system relies on secure supply chains,⁴ a large workforce, and funding to function,⁵ however these areas have been severely reduced or altered during the pandemic, contributing to increased pressures on healthcare delivery. An area of healthcare which has been inundated with pressure as a consequence of the pandemic is waste management.⁶

Healthcare waste has been exacerbated due to the infection prevention measures required to reduce the spread of COVID-19.⁶ Pandemic associated waste includes face masks, testing kits, personal protective equipment (gowns, gloves), disinfectant items, plastic packaging⁷ and other provisions which come into contact with isolated patients such as food. After the initial outbreak in Hubei Province China, medical waste increased by 370%.⁸ As a result, healthcare services have had to produce innovative storage, handling, and management strategies to adapt to the unparalleled output of infectious waste.⁹ Unfortunately, this waste is disposed of via high temperature incineration or sanitary landfill after treatment,⁹ reversing progress in reducing and managing waste in line with the UN Sustainable Development Goals of 'responsible production and consumption'.¹⁰ Hospital food services is one department whose operations have been impacted by the COVID-19 pandemic and its resulting increase in waste.

Historically, hospitals experience high levels of food waste, with food waste making up 50% of the total waste by volume in some hospitals.¹¹ Reasons leading to this volume of waste include; patient appetite, food quality and quantity, and food service model limitations such as ordering meals 24-h prior to consumption.¹² This large amount of food waste is concerning as it contributes to the already significant volume of food waste disposed of to landfill, which results in the generation of significant greenhouse gas emissions (3% of Australia's annual emissions).¹³ During heightened times of COVID-19 outbreaks, rising patient numbers have created challenges for hospital food services to guarantee food supply and usual menu options, to forecast expected meal numbers, and measure waste levels accurately. Furthermore, anecdotal reports suggest regular food service practice has been significantly impacted by reductions in staff, cessation of quality improvement projects, dissolved production and distribution systems, and increases in food

waste. In contrast, the acceleration and modernisation of other areas of hospital nutrition practice have occurred, including care delivery via telehealth,¹⁴ the installation of electronic menu systems and intake assessment tools,¹⁵ as well as the rapid development of nutrition guidelines for management of COVID-19 patients.¹⁶ Despite these solutions, the pandemic has correspondingly highlighted the requirement for reliable food procurement systems, and exposed the continued need for sustainable waste management within hospital food services.¹⁷

Healthcare services are obliged to deliver food and nutrition care to patients to support their recovery and hospital food services are at the core of this necessity. However, the importance of this department's contribution to healthcare may be overlooked. While there has been a focus towards understanding the increased demand on overall healthcare waste management due to COVID-19,^{6,8,9} there has been limited documentation discussing its impact within hospital food services. Therefore, the aim of this research was to explore the impact of the COVID-19 pandemic on hospital food services, particularly on food waste and the completion of food waste audits.

2 | METHODS

A qualitative research design was used, from the philosophical positioning of interpretivism as the researchers were exploring participant's subjective perspectives around the research matter.¹⁸ Interpretivism assumes a relativist ontology whereby there are multiple realities which are constructed by the meanings and interpretations individuals give their previous experiences.^{18,19} Conducting this research from an interpretivist paradigm was appropriate as interpretivism considers knowledge to be socially or co-constructed from the interactions between the researcher and the participants,^{18,20} and is why interviews were selected as the data collection method.¹⁹ This approach aligns with interpretivism because the research questions focus on asking participants how and why something occurs, which facilitates the researcher to build a new understanding on the investigated topic in addition to their previous knowledge, as an outcome from valuable discussions with participants.¹⁹

This research is a secondary analysis of a dataset originally generated to explore food waste audits in hospital food service. The original research questions were to identify the perspectives of staff involved in the operation of hospital food services on (1) the barriers and enablers to conducting routine food and food-related waste audits, and (2) how an evidenced based consensus pathway food

waste audit tool is perceived to translate into practice within hospital food services. Conducting semi-structured interviews from an interpretivist view allows researchers to accept the existence of multiple realities, focus the conversation on complete experiences, prompt to explore unexpected outcomes and seek a deep understanding of the topic.²¹ As it unfolded, this research about food and food-related waste audits provided a launchpad to explore COVID-19 and its impact on food waste and food waste auditing. This study was approved by the Monash University Research Ethics Committee (Project ID: 28908) and was developed and reported using the Consolidated criteria for reporting qualitative research (COREQ) guidelines.²²

The setting for this research was hospital food service. Through the allocation of a random number²³ to a list of all the public hospitals in Victoria,²⁴ 10 hospitals were contacted fortnightly. This technique of maximum variation sampling was intended to provide a widespread and varied sample of hospitals with a diverse range of characteristics (e.g. size, location, COVID-19 site), food service models and organisational structures and values which were anticipated to influence the phenomenon of waste management under study.²⁵ From these hospitals, individuals who worked within, or governed, hospital food service operations and had knowledge relating to hospital food service operations were purposefully sampled²⁶ (e.g. food service workers, food service managers, waste management staff, financial officers and sustainability officers). Their real world experiences 'on the ground' during COVID-19 made them a valuable information-rich data source. Snowball sampling was also used whereby participants were asked to reach out to any colleagues within their health service who they thought may be suitable participants and request that they contact the research team via email.²⁷ Justification for the appropriate sample size was guided by evidentiary adequacy,²⁸ meaning the researchers needed to collect an adequate amount and variety of evidence, and the evidence must be interpretive, disconfirming and discrepant. These conditions were considered satisfactory in the collected dataset by the research team.

Hospital administrators were contacted by phone to request contact details of operations managers. Operations managers were contacted via email and asked to identify and provide contact details of key informants who met the eligibility criteria. Operations managers were contacted due to their position in the hierarchy of hospital food services, their assumed understanding of research value, email accessibility, and connection to the desired participants. When recommended participants contacted the research team, more details were shared by the primary researcher via email including an explanatory statement, consent form, organisational permission

letter, and further information on the interview topic. Interviews were scheduled once participants returned both a signed consent form and organisational permission letter.

Prior to data collection, the interview guide was piloted with food service dietitians and other researchers, with refinements made as needed. The interview was designed for the primary study and consisted of semi-structured questions related to the barriers and enablers towards the completion of hospital food waste audits, and the use of a consensus tool to support food waste audits.²⁹ The interview guide included six key questions which centred on understanding participant perspectives on the following topics: participant role in the food service, barriers to audit completion, enablers to audit completion, strategies to incorporate audits in practice, thoughts on the consensus tool, and how the consensus tool could support their practice. Prompting was used as needed to enable participants to elaborate in greater depth for four of the questions, for example '*What else may support this process further?*'. There were no specific questions relating to the COVID-19 pandemic and its impact on hospital food services, however this issue frequently emerged.

Interviews were conducted with the video communications program Zoom (Version 5.5, Zoom video communications, California) during Victoria's second wave of the COVID-19 Delta variant and the 6th lockdown period³⁰ between August and November 2021. They were facilitated by the primary researcher who was a PhD candidate and Accredited Practising Dietitian with prior experience working in hospital food service as a Dietitian Assistant and who has conducted research in hospital food waste auditing. Interviews were audio recorded. At the beginning of the interview the primary researcher introduced himself, explained his relationship to the research, and collected demographic data for descriptive purposes. Participant data collection included their age, gender, position, years in their current position and previous food service experience; hospital data collected were size and food service model. Interviews were not repeated and transcripts were not returned to participants for verification (member checking) to minimise research burden at a busy time. However, additional email exchange to clarify or share information occurred for up to 2 weeks post interviews. Field notes were not taken so the interviewer could dedicate their focus to the conversation to facilitate rich information sharing, however to facilitate reflexivity the interviewer discussed the data and debriefed fortnightly with two members of the research team (senior researchers with experience in qualitative methods and the topic area).²⁶

TABLE 1 Participant ($n = 20$ participants) and hospital ($n = 11$ hospital sites) demographics

Demographics	Response	n (%)
Gender	Male	8 (40%)
	Female	12 (60%)
Age	20–30	3 (15%)
	31–40	6 (30%)
	41–50	4 (20%)
	51–60	5 (25%)
	61–70	2 (10%)
Position	Food service dietitian	4 (20%)
	Hotel service coordinator	2 (10%)
	Support services manager	1 (5%)
	Food service project officer	1 (5%)
	Special projects coordinator	1 (5%)
	Food safety supervisor	1 (5%)
	Food service manager	1 (5%)
	Store person	1 (5%)
	Head chef and food service coordinator	1 (5%)
	Group management support services	1 (5%)
	Sustainable food systems dietitian	1 (5%)
	Catering team leader and dietitian	1 (5%)
	Catering manager	1 (5%)
	Dietetics department manager	1 (5%)
Chief sustainability officer	1 (5%)	
Length of time in current work role (years)	<1	6 (30%)
	<5	9 (45%)
	5+ to 10 years	2 (10%)
	10+	3 (15%)
Hospital size (bed numbers)	0–100	3 (15%)
	101–300	4 (20%)
	301–500	2 (10%)
	500+	2 (10%)
Food service type	Cook chill	5 (45%)
	Cook fresh	2 (18%)
	Cook chill and cook freeze	1 (10%)
	Cook freeze	1 (10%)
	Cook fresh and cook freeze	1 (10%)
	Cook chill and cook fresh	1 (10%)

Demographic information was collated and analysed using descriptive statistics in Microsoft Excel version 16.0. Interviews were transcribed using artificial intelligence software, Otter.ai (Version 2.1.52, Otter.ai, California), and were checked in full to ensure accuracy, whereby the interview recording was reviewed

simultaneously while errors in transcription were changed. A six-phase inductive thematic analysis was then utilised for data analysis.³¹ This process included the primary researcher importing each transcript into NVivo (NVivo, QSR International, Victoria) to read and iteratively code. Concepts that represented an important idea

in relation to the research questions were identified and coded, and as new codes were identified from the data, previous transcripts were re-examined. One researcher (with extensive qualitative research experience) reviewed 10% of the coded transcripts alongside the primary researcher. Codes that shared meaning or when combined told a story were then collated into themes and shared with the research team for discussion and consensus.

3 | RESULTS

Seventy hospitals were contacted to participate in this research. The most common reasons for hospitals not accepting the invitation to be included were hospitals not sharing participant contact information, lack of response from contacted individuals, or invitations being declined as a result of priority and time pressures. A total of 21 participants (Table 1) were interviewed across 12 different hospital sites. One participant (data not included) retracted their consent to participate and their data were removed from the analysis.

Eight participants were male, the average (\pm standard deviation) age of all participants was 44 ± 11 years. There were 16 different position titles, however crossover was evident between the reported participant responsibilities. The mean period of employment at the current health service was 5 ± 6 years. Participants reported a plethora of previous experience in hospitality, food service and the healthcare system. Hospital size ranged from 18 to 600 beds and cook chill was the most common food service type used. The mean interview time was 64 min (range 50 to 94 min).

The following results describe the major themes identified from participant interviews relating to the COVID-19 pandemic and its impact on hospital food services, food waste levels, and their ability to complete a food waste audit. The five major themes were: impacts on practice, labour, change, technology and post-pandemic expectations.

Participants reported that infection prevention measures presented by COVID-19 led to increased pre-packaged single serve food items and disposable utensils and crockery being placed on patient trays; these were not returned to the kitchen if unconsumed or unused. Because waste was disposed of in patients' rooms, this limited the ability for hospitals to visualise or measure plate waste or aggregate food and food-related waste from COVID wards and isolation rooms.

In our [COVID-19] suspect rooms, here in the hospital, and any isolation room, we send up

disposable crockery, cutlery, everything. So, everything gets disposed of in the room in the infectious waste ... So, the only thing we get back out of that room is the tray, which we then clean properly. So as far as their food waste goes, we've got no idea on that side, because it just goes into the infectious waste. (Participant 6, Food service manager)

At some hospital sites, where pre-pandemic usual practice was to re-use, keep, or donate unused suitable food items, this was no longer permitted. One participant (Participant 18, Dietetics department manager) gave the example of unused Enteral Feeds and Oral Nutrition Supplements being sanitised and sent back to wards, but reported that these practices would never be endorsed during COVID-times.

The increase in waste was perceived as a negative outcome from the pandemic by numerous participants. Food waste, disposables and personal protective equipment used throughout the hospital, including the food service, were visibly obvious to participants and were not previously considered usual practice. A food service dietitian elaborated on how they were creating new policies and practices to attempt to feed patients and permit staff to enter their rooms. These frequent changes to hospital protocols and procedures were reported to impact the ability of staff to focus and conduct standard responsibilities.

It's just a constant changing environment, and we're just playing catch up, and it's very hard to think of doing anything other than just getting through the day at the moment. (Participant 12, Food service dietitian)

Another change to the working environment at one paediatric hospital was the regular daily influx of 30 patients and their parents for COVID-19 testing. The hospital had to provide additional meals for these patients and families, meaning a consistent overproduction of food to ensure everyone received a meal, which impacted forecasting and led to increased food waste.

Staffing challenges was a major theme that emerged from the interviews. Participants reported difficulty recruiting staff during the COVID-19 pandemic, others transferred into new roles, higher than usual sick leave occurred, and fewer students were allowed onsite to contribute to quality and research projects.

The last 18 months has been insane as far as recruiting into health services, and I think we're not the only industry that's been affected. But it's been, I think I've conducted

300 interviews over the last 12 months and I don't have any staff I've employed out of those 300 interviews ... Our sick leave is up, we're looking at 10 EFT (equivalent full time hours) out of a week, on average, that were due to sick leave. So that's as a result of COVID. Obviously, we're not going to be in COVID for the rest of our lives, I hope But the things that you know, when you've got that sort of sick leave coming out of any part of the organisation, it does put stress on managing processes. So sometimes things have to give. (Participant 11, Group management support services)

A Food service manager (Participant 6) described how their hospital was a COVID-19 hot spot, which required staff members to be furloughed. Another participant (Participant 10, Food service dietitian) described how they were developing a contingency plan in case a similar scenario were to happen at their facility, which would leave no staff to cook meals for patients. Prioritising this plan was viewed as more urgent than completing a food waste audit, regardless of its importance.

When asked how to overcome the barrier of high sick leave, one participant (Participant 17, Food service dietitian) suggested that if food service staff could be more involved with individual patient stories, it may enhance their profile and their understanding of the importance of their role. The rationale behind this idea was that because food service staff are often located in the basement of the hospital or off-site, they are often disconnected from the reasoning for patient nutrition requirements. However, COVID-19 was a barrier to rationalising this strategy.

One participant (Participant 15, Catering team leader) reported losing staff members due to the vaccine mandate laws,³² which created more work for remaining staff. Furthermore, there appeared to be a cumulative pressure on food service staff as a result of working in healthcare during the pandemic.

Because like I said, it's something I'm working with myself trying to get the staff motivated a little bit more, but it's just been definitely really hard this past year with the COVID restrictions. Everybody's just worked to the bone, everything's, everybody's struggling pretty hard and just trying to get by at the moment. (Participant 15, Catering team leader)

Due to the COVID-19 pandemic hospital food service practices were forced to adapt and change. In some cases, these changes were immediate, while others took time to

take effect. Participants reported different changes such as a decrease in the number of clinical recycling waste audits, disruption to the introduction or continuation of surplus food charity collections, a reduction in catering services, ingredient suppliers being out of stock, and the extension of an external food service provider contract.

People don't really like change. So as far as the past 18 months, COVID has bought, I've never seen so many changes in my professional career as far as COVID has bought to us. So, I think staff have, well, they've had no other reason, and no other choice but to, to accept change. (Participant 11, Group management support services)

A positive example from one hospital was the creation of a new role, the 'ward host'. The responsibilities of this position were to collect patient orders on the wards and notify the kitchen of changes to patient menu choices. This role had a significant impact on food waste and generated time savings for food service, who previously would unknowingly cook meals for discharged, fasting, or deceased patients.

Additionally, COVID-19 was believed to be an excuse for not changing practice or completing a food waste audit, even if it was specified in a mandated document.

Because, you know, even if it [food waste auditing] does get into some sort of internal document, it could just not be achieved. People could just not do it. It can just, you know, there'll be an excuse, like, COVID or whatever. We didn't get around to it, and that'll be fine. (Participant 13, Food service dietitian)

Technology was viewed as an obvious solution to the contact restrictions and food service delays presented by COVID-19. Implementation of an electronic plate waste measurement strategy was being trialled at one hospital, whereby students used visual estimation to estimate and enter patient food waste percentages into a device attached to the collection trolley before it reached the kitchen. The dietitian from this hospital (Participant 10) said that she could observe changes in patient intake after just 3 days of data. Other hospitals who were aware of this strategy praised its practicality, while those who were not, explained (without mention of an electronic plate waste measurement strategy by the interviewer) that using an identical strategy such as an electronic application across multiple devices, would support them to collect patient intake data and measure food waste.

... we really need to have it all sort of like electronics, so it's easy just to go. It's a percentage of what's left on the plate. So, let's say they've eaten 10% of the plate, if you have an input of what the meal is, like casserole and mashed potato, peas and carrots, you can just go on an overall, you know, like there's 40% of the casserole eaten and x amount of veg and the starch. Or you can actually do it as a whole meal, but it was 60% or 20% of the meal, it's easy just in percentages, because once people get used to it, and you actually take a few photos along the way, you get a good visual of what is actually eaten. And that would be simple to do, you can actually do it. You can actually almost get, the whole hospital audited instead of just one ward at a time. (Participant 20, Facilities services manager)

Participants described how the benefits of electronic menu systems were supportive in managing and collecting data that streamlined food service operations, however this technology was not available at all health services interviewed. One participant (Participant 14, Hotel services manager) explained that they did not have an electronic menu system due to the high financial outlay required, so they relied on staff to manually collect and recall data, and speculate meal numbers needed. Another participant (Participant 20, Facilities services manager) commented that the electronic menu system they used did not have the capacity to input food waste data. Conversely, a number of participants reported the positive outcomes experienced from having an electronic menu system in operation, such as the opportunity to retrospectively obtain information from past food services, instantly share patient intake data, and accurately forecast meal numbers.

Data that gets entered into our food system, that's then accessible by dietitians, speech pathologists, it's also accessible by food service management. That gives us insights, and maybe as a way of accessing quality or understanding quality of our meals. We may think we're producing a great meal, but plate waste is coming back consistently at 50%. What's wrong with the meal? How do we improve quality? So, those sorts of things come into play, as well. (Participant 11, Group management support services)

Moreover, participants also mentioned that changing the food service delivery model to a room service design

could possibly reduce waste and stagger food waste collection throughout the day.

... because they've got that centralised breakfast, lunch and dinner plating, collecting all at the same time which makes it very time driven, something like a room service on demand model where you are taking up smaller: a) the patient's order what they want, when they want it, so they're more likely to eat more of it, but b) you're probably collecting less meals at a time. So therefore, the staff probably have more time to be able to look at that waste because they're not having to collect hundreds of meals. They're just collecting a smaller trolley of meals. (Participant 17, Food service dietitian)

Some participants were looking towards the end of the COVID-19 pandemic. They explained that 'once COVID moves on' the changes to food service operations will return to normal. However, one health service was expecting an increased workload focussing on sustainability projects post-pandemic and were therefore planning to hire two more sustainability professionals. The Chief Sustainability Officer (Participant 19) for this health service commented that once these positions were appointed, if a food waste audit were deemed a priority, they would then have the resources to complete one.

4 | DISCUSSION

It is evident that the COVID-19 pandemic has had a considerable impact on hospital food service operations. Changes experienced by individual hospital food services in Melbourne comprised of labour duties, routine procedures and the recruitment of staff and students, whereas broader variations to the entire healthcare food system such as technology requirements and alterations in the food supply chain were experienced by the whole state of Victoria. Further, the COVID-19 pandemic has resulted in increased food waste and a reduction in the workforce's capacity to prioritise and complete food waste audits. The response of food service staff has been to modify their practice, demonstrating their resilience, creativity and adaptability.

The large variations in the global healthcare system due to the pandemic triggered downstream involuntary change to all hospital departments, including food services. This pressured hospitals to rapidly change practices that would guarantee the safety of their staff by limiting virus transmission, including physical distancing, and

increased hand hygiene precautions.³³ The reduced capacity to place nutrition and dietetics students in hospital food services to complete food waste audits as part of these changes exposed food services' reliance on these students to complete this task. However, perhaps the increased use of technology-focused solutions found in the current study, in the form of electronic plate waste measurement systems and electronic menu ordering systems, which were trialled and implemented, or included in business cases, to support COVID-safe food service operations will reduce this reliance. It is noted that electronic plate waste measurement systems only capture food that patients do not eat.¹⁵ Measuring aggregate hospital food waste which includes preparation and plating line surplus is useful in understanding waste on a higher level. There is technology available that addresses this issue,²⁹ but this was not mentioned by participants in this study. Recent research has investigated and validated the benefits of integrating technology into hospital food service operations, including functional efficiencies, reductions in food waste and cost.¹⁵ COVID-19 has accelerated the need for, and integration of, these tools to support hospital nutrition care amid contact restrictions and staff shortages. The success of these technologies may see them remain as 'standard procedure' in food services post-pandemic. The future may see a reallocation of resources to further implement these technological advancements in other areas of hospital food service operations that were stressed by the extremities of the pandemic, such as food waste auditing.

Despite the global impact of COVID-19 on the health system, climate change still remains the number one threat to the provision of healthcare.³⁴ COVID-19 has delayed and disrupted the health system's response to the growing danger of climate change and has highlighted the enormous, as well as rapid, change required when disaster strikes.³⁴ The global healthcare system contributes 4.4% of total greenhouse gas emissions, which effects human and planetary health.³⁴ Unfortunately, the green recovery from COVID-19 to this point has not been prioritised in Australia, although 50 other countries at the recent United Nations Climate Change Conference (COP26) committed to building health systems which can withstand climate change impacts.³⁵

Globally, many lessons were learnt once the frailty of the current food system was exposed, including the disruption of supply chains from paddock to plate,³⁶ that led food services to question the sustainability of their food supply. The 2021 United Nations Food Systems Summit³⁷ aimed to generate action and identify progress towards the United Nations Sustainable Development Goals.³⁸ If the Sustainable Development Goals are to be met by 2030, transforming food systems to be more resilient and

sustainable must be a high priority for the nutrition and dietetic profession. This has been recognised as the third most needed theme of nutrition research,³⁹ and one of six emerging roles for dietitians in the future.⁴⁰ Additionally, a recent position paper from Dietitians Australia endorsed the need for a food systems transformation to support healthy and sustainable diet-related practices, including institutional food services.⁴¹ Despite the negative impact of the COVID-19 pandemic on the progression of the Sustainable Development Goals,¹⁰ organisations are still committing to meet them. For instance, International Service System Facility Services (who were represented by participants in this study), have announced they are aiming to halve food waste in all their United States branches by 2024.⁴² Furthermore, 78% of Practice Greenhealth affiliates (a membership for sustainable healthcare) are reducing food waste.⁴³ These examples demonstrate that some institutional food services are acting to improve their operations, and attempting to build back better after the COVID-19 pandemic, which may support their response during the next emergency.

Interviews were completed in the Australian state of Victoria, which contains the city of Melbourne, the most locked-down city in the world during the COVID-19 pandemic.³⁰ As a result, this made hospital and participant recruitment for this study challenging, as managing COVID-19 was a higher priority. In addition, this led to a low participation of food service staff who complete kitchen tasks such as cleaning, preparing food, and washing up after service as they were either preoccupied with service or not approached by their manager to participate. These individuals may have provided important insights for informing the research questions. Completion of interviews with hospital food services located in Victoria and no other Australian state may be viewed as a limitation of this study, however this was a practical approach to recruitment. Qualitative interviews were conducted via Zoom (Version 5.5, Zoom video communications, California) which reduced the exposure of subtle in-person cues that aid interview questioning, as well as caused minor technical difficulties, interruptions and delays. The pandemic has led to an increase in the acceptability and popularity of video communication to complete previous face-to-face interactions, consequently participants were familiar and comfortable with this format. A strength of this study is its internal coherence, which enhances its quality.²⁰ This was demonstrated by the chosen philosophical paradigm of interpretivism (a relativist ontology and subjectivist epistemology)¹⁸ aligning with the researcher's axiology of placing value in participants' social context and their perspectives, that led to a qualitative descriptive study design (methodology) and semi-structured interview data collection

method.²⁰ Declaration of the researcher's position to the participants at the start of the interview, regular peer-debriefing and a collaborative analysis approach supported reflexivity.

This research demonstrated the effects of the COVID-19 pandemic on hospital food services, specifically in the areas of food waste auditing and on the generation of food waste. Although COVID-19 created a 'tug of war' scenario between the use of resources and individual safety, hospital food services showed resilience in their practice. Forced changes in resource allocation and usage allowed food services to adapt and learn to work with COVID-19 restrictions, potentially beginning the path to post-pandemic services. While this study describes the impact of COVID-19 on hospital food services, food waste and audits, complementary future research should measure the impacts of COVID-19 on other metrics including patient intake, staff turnover, and food costs. Further research focussing on measuring aggregate food waste and the outcomes of strategies to reduce or divert food waste from landfill are also desirable. The advancement towards sustainable healthcare will then support and potentiate the green recovery from COVID-19.

AUTHOR CONTRIBUTIONS

NC conducted the interviews, collated, analysed and interpreted the data and wrote the manuscript. DG, JC and JP supervised this process and critically reviewed the manuscript. All authors contributed to the conceptualisation and design of the study and have read and approved the final publication. The contents of this manuscript have not been published elsewhere.

CONFLICT OF INTEREST

Prof. Judi Porter is Editor-in-Chief of Nutrition & Dietetics. She was excluded from the peer-review process and all decision making regarding this article. This manuscript has been managed throughout the review process by the Journal's Editor. The Journal operates a blinded peer review process and the peer reviewers for this manuscript were unaware of the authors of the manuscript. This process prevents authors who also hold an editorial role to influence the editorial decisions made. All authors are in agreement with the manuscript and declare that the content has not been published elsewhere. Other authors declare that there is no conflict of interest to report. The scholarship funders had no role in the design, analysis or writing of this article.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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