

PLATE WASTE IN THE NATIONAL SCHOOL LUNCH PROGRAM: ROOT CAUSE ANALYSIS, REVIEW, AND EDUCATIONAL IMPLICATIONS

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ABSTRACT

Plate waste is a significant financial burden on a resource-limited National School Lunch Program (NSLP). Pilot programs and case studies have identified interventions that can reduce waste; however, the problem persists on a national scale. The purpose of this paper is to explore use of a new method of inquiry in addressing a long-standing problem, Root Cause Analysis (RCA). RCA was used to identify major factors causing NSLP plate waste. We review efforts made thus far in combating plate waste in NSLP and offer additional ideas for study. Educators can use this approach in teaching other concepts in foodservice management.

Keywords: plate waste, root cause analysis, National School Lunch Program, food waste, child nutrition

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INTRODUCTION

According to recent estimates by the United States Department of Agriculture (USDA) (2016a), approximately one-third of the world's post-harvest food supply is wasted annually. The field is bereft of explicit data, but the consequences of wasted food are significant in terms of economic, environmental, and broader ethical impacts (Gjerris & Gaiani, 2013). Nearly \$161 billion worth of food is wasted annually in the United States (U.S.) (Buzby & Guthrie, 2002). Reliable estimates of costs associated with processing of this waste are lacking. It is estimated food-related waste accounts for 20% of solid municipal waste, with associated handling/dumping fees corresponding to more than \$2 billion in 2010 U.S. dollars (Environmental Protection Agency [EPA], 2017) and over four gigatonnes or 16 billion joules of energy (United Nations, 2015).

Ironically, food insecurity is a concern in the U.S. with an estimated 1 in 5 children experiencing unreliable access to safe and nutritious food, and lack of adequate nutrition can lead to life-long health complications and affect students' readiness to learn (Bhattacharya, Currie, & Haider, 2004). To address these damaging consequences, USDA and the EPA have initiated Food Waste Challenge and Food Recovery Initiatives. These efforts have focused primarily on food waste. Yet a good portion of the food waste (USDA estimates 30%) can be defined as *plate waste*, which is edible food that is discarded. Reasons for plate waste are many, and the behavior is thought to be a manifestation of cultural ingraining (Birch & Marlin, 1982).

Waste within the National School Lunch Program (NSLP) is a subject of interest in the academic community and among practitioners, but has failed to gain traction as a national policy issue. Estimates suggest that between 11 to 45% of food placed in front of children participating in the NSLP is wasted (Byker, Farris, Marcenelle, Davis, & Serrano, 2014; Getlinger, Laughlin, Bell, Akre, & Arjmandi, 1996; Schwartz,

Henderson, Read, Danna, & Ickovics, 2015; Strohbehn, et al., 2016). Studies have reported plate waste both before and after implementation of the Healthy and Hunger-Free Kids Act of 2010 (HHFKA, 2010), which updated nutrition guidelines for the NSLP effective 2012 (Adams, Pelletier, Zive, & Sallis, 2005; Baik & Lee, 2009; Cohen, Richardson, Austin, Economos, & Rimm, 2013; Cullen, Watson, & Konarik, 2009; Davis, Cullen, Watson, Konarik, & Radcliffe, 2009; Fenton et al., 2015; French & Wechsler, 2004; Knai, Pomerleau, Lock, & McKee, 2006; Neff, Spiker, & Truant, 2015; Parfitt, Barthel, & Macnaughton, 2010; Price & Just, 2015; Reger, Clesi, Nicklas, Shi, & Berenson, 1995; Schwartz et al., 2015; Smith & Cunningham-Sabo, 2014; Strohbehn et al., 2016; Templeton, Marlette, & Panemangalore, 2005). When 30% estimated plate waste is calculated in 2002 dollars, losses of over \$600 million are seen (Buzby & Guthrie, 2002). This loss amount accounts for the purchased value of the food that is wasted, and costs of storing, preparing, and serving, but it does not capture costs such as lost health benefits or misdirected capital expenditures. Further, these estimates were calculated only for the NSLP, not all food programs offered in schools, such as the National School Breakfast Program. Thus, it is important future managers in foodservice settings understand the plate waste problem to ensure effective management of available resources.

There have been many reasons presented as to why food served in the NSLP is not consumed. Time allowed for lunch (Cohen et al., 2016; Price & Just, 2015), scheduling of recess (Getlinger et al., 1996; Hunsberger et al., 2014; Price & Just, 2015; Read, 1985; Strohbehn et al., 2016; Tanaka, Richards, Takeuchi, Otani, & Maddock, 2005), social influences (Neff et al., 2015; Qi & Roe, 2016), types of service and food preferences (Cohen et al., 2012; Ohri-Vachaspati, Turner, & Chaloupka, 2012; Smith & Cunningham-Sabo, 2014) have all been identified previously as reasons for plate waste. Yet, studies have not addressed multiple, integrative dimensions of the plate waste problem.

This suggests that a complete conceptual understanding of plate waste in NSLP is needed. To date, there have been no published *systematic* analyses of the reasons for plate waste in the NSLP, only survey-based methods of identifying proximate causes. One potential approach to improving understanding of the multi-dimensional plate waste problem is Root Cause Analysis. Root Cause Analysis (RCA) is a rigorous problem-solving method that aims to identify root causes of disadvantageous processes or events, traditionally *ex post facto*, through the systematic and documented asking of the question "Why?" of a carefully crafted problem statement (Bagian et al., 2002). The "Why?" question is asked until repeat appearances of themes emerge. Identification and addressing root causes can lead to a substantive decrease in incidence of the disadvantageous process and result in lasting change (Bagian et al., 2002; Rooney & Vanden Heuvel, 2004). RCA's adoption as a formalized technique within the realm of education has been limited to health care settings, but there is potential usefulness of the tool to fully illustrate the complexity of a

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question and lead to enhanced levels of inquiry among students in other fields, as well as potential for policy intervention.

In this paper, we utilized RCA, a method novel to the field of foodservice management and child nutrition research, to initiate an in-depth exploration of plate waste in the NSLP. Our goals in this work were: 1) to more comprehensively describe the plate waste problem as presented in the literature from multiple perspectives, 2) review current initiatives to address plate waste, 3) provide recommendations for action steps to combat this problem using a holistic approach, and 4) employ new methodology in child nutrition research and foodservice management education. Findings contribute to the body of knowledge about plate waste in NSLP and effective educational strategies.

METHODS

Root Cause Analysis

RCA process involves 5 key steps: 1) identify problem, 2) identify target population, 3) develop problem statement, 4) perform hypothesis-free “brainstorming” by asking sequential “Why” questions, and 5) validating sampling of findings with experts, either through a “blue ribbon” expert panel or literature search. The problem of plate waste as it impacts those participating in the NSLP focused on a targeted population of students of all ages. The problem statement developed was: “Students waste too much NSLP food”. From this statement, identification of root causes was made following a flow chart approach through a series of “Why?” questions. “Why?” questions continued until ideological saturation had been reached, or until particular root causes began reappearing. Of note, branch points were not always mutually exclusive. The process also took into consideration food presented to the population and the environment (operational and social aspects) in which NSLP functions. Because of this, findings were validated by a combination of authors’ expertise and review of literature.

Data Visualization

PowerPoint (Microsoft; Redmond, WA) flowchart development was initially used for documentation of root causes. Flowcharts were developed for each step of root cause analysis, with each linkage in a hierarchical flowchart representing the question “Why?”. Data are presented at the level of initial “Why?” question. Space limitations and the overall cumbersome nature of full RCA hierarchy flowchart preclude its publication. Data file of source figure is available upon request.

Literature Review

Next, subjective evaluation of identified causes by the authors (with expertise in foodservice management and school nutrition) was performed and root causes re-clustered into searchable and reviewable domains by use of word cloud (also available upon request). Literature review commenced with individual searches of the format “(Root cause)” + various forms of “waste”, “food waste”, and “plate waste” + various forms of “school lunch”, “school lunch program”, “NSLP”. Literature reviewed was not limited by discipline. For example, database searches included PubMed and ISI Web of Knowledge in addition to conventional foodservice management publications, such as this journal. There was no date cutoff or country of origin restriction for selected literature. One hundred thirteen references were identified in initial search efforts. Each reference was independently reviewed by authors for content applicability to root cause analysis. References that mentioned NSLP only in passing were not used. Forty-two references were found to have applicability to the results of root cause analysis. Of these, thirty were academic journal articles from the primary literature; three were laws and/or legal analysis; and nine were government reports.

RESULTS OF RCA

The first major branch point of RCA shows that plate waste is a result of insufficient demand, oversupply, and/or an insufficient re-use of food (Figure 1). Fundamentally these three branch points capture the mismatch of supply and demand and the lack of a diversion plan for prepared food that would otherwise be served.

Insufficient Demand

RCA and subsequent ‘Why?’ questioning identifies possible reasons for insufficient demand with further investigation listing associated root causes: 1) absence of hunger, 2) presence of hunger but *logistical inability* of the child to eat the food (e.g. lack of time), 3) presence of hunger but *lack of desire* to eat the food (e.g. bad taste), and/or 4) presence of hunger but *dietary inability* to eat the food (e.g. allergy) (Figure 2). Thus, these root causes can be managed into two clusters:

1. Unpopular or unsatisfactory food served
2. Structural or logistical issues that decrease ability to finish a meal

Oversupply

A similar process was used to investigate the branch labeled as “Oversupply” (Figure 3). Subsequent investigation identified poor procurement, preparation, inventory management, and service practices as possible proximate causes. RCA further delves into the limb of poor procurement to identify these root causes:

1. Absence of “smart” procurement practices leading to unnecessary purchases
2. Absence of accurate forecasting methods leading to inflated orders
3. Lack of feedback about plate waste and incorporation into procured amounts

Inappropriate service practices would include attempting to provide more food to a student who is perceived by staff member to need it or providing a serving that is larger than the recommended portion, either to every student, favored students (such as the student athlete), or to those who come through a serving line when a serving pan of an item is near completion.

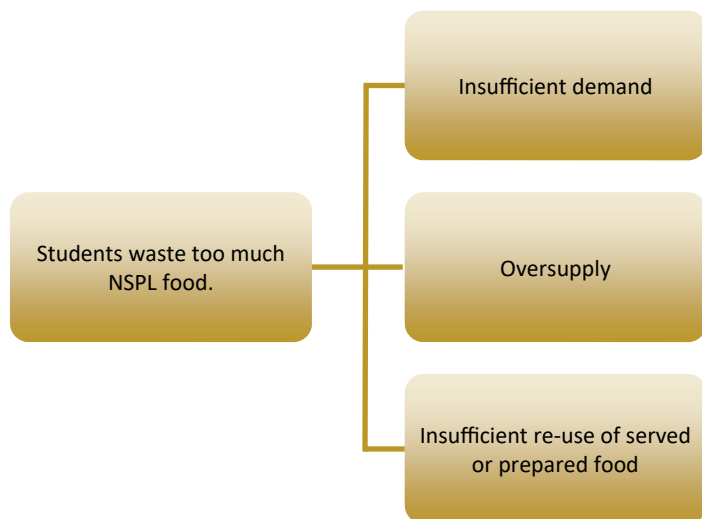


Figure 1. Root Cause Analysis of Plate Waste in the National School Lunch Program First branch point of root cause analysis beginning from problem statement. In all figures, branch points in the hierarchy represent the question ‘Why?’ and connect causes.

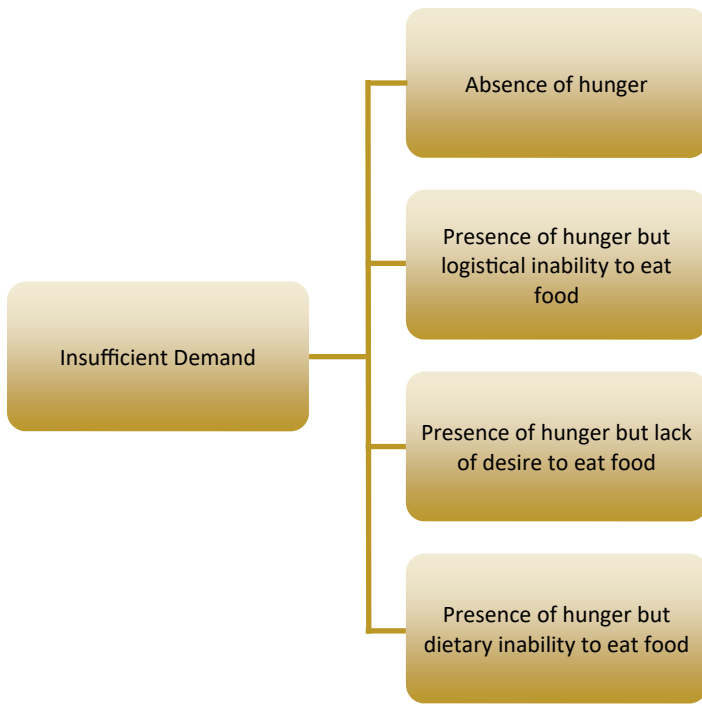


Figure 2. Insufficient demand and Associated Causes of Plate Waste in the National School Lunch Program. Identification of proximate causes of insufficient demand for NSLP food.

Insufficient Re-use

The third major branch of the RCA was insufficient re-use of NSLP food. RCA identified reasons such as insufficient knowledge or ability to re-use served food, unrecognized need for donation, insufficient incentives for donation or re-use, and/or absence of structural or logistical support for donation or re-use (Figure 4). Further analysis revealed root causes of:

1. Lack of education about food insecurity in the community
2. Local health agency restrictions regarding re-use of served foods
3. Costs associated with storage and security of reusable food
4. Lack of policy encouraging food donation/reuse

Results from this RCA of plate waste in NSLP show the complexity of the issue and how best foodservice management practices are important tools in reduction efforts. The RCA process provided a visual representation of the integrative aspects of plate waste. From these findings a discussion and review of current and proposed strategies to minimize plate waste evolves.

REVIEW AND DISCUSSION

The visual representation of the RCA process can be a useful tool in presenting complex problems. The RCA approach can encourage students’ critical thinking and analytical skills with investigation of a particular problem. Findings from this RCA showed plate waste is a result of insufficient demand, oversupply, and/or an insufficient re-use of food. From these findings a discussion and review of current and proposed strategies to minimize plate waste evolves.

Addressing Insufficient Demand

RCA investigation revealed that effective strategies could include changing the food that ends up on plates. Potential strategies include use of offer versus serve; increased exposure of students to food items; implementation of fruit and vegetable programs; and changing

structure of the meal program, such as meal time scheduling to promote increased appetite.

Offer versus Serve: Root cause analysis revealed, as above, that one cause of plate waste is students literally having too much on their plates (USDA, 2015). Offer versus serve (OVS) and serve only (SO) are approaches used in many schools through salad bars and other self-service food bars. The literature is mixed on impact of these on reducing plate waste, perhaps due to variations in data collection procedures and difficulty in comparing amongst different portion sizes. In a case study investigating plate waste associated with recess scheduling (Strohbehn et al., 2016) found selection time was lengthened at self-service food bars, thus contributing to plate waste due to *logistical inability* to consume food in remainder of lunch period. Other work in this area has failed to show a statistically significant increase in fruit and vegetable consumption when served

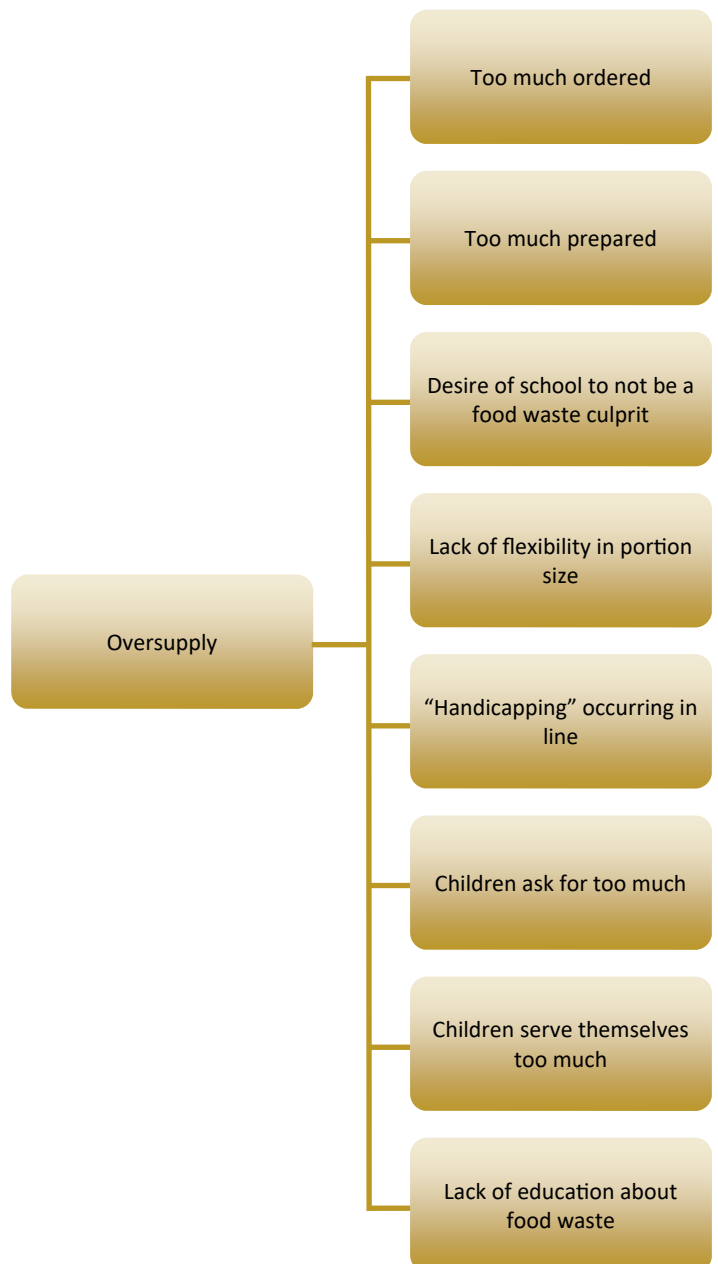


Figure 3. Oversupply and Associated Causes of Plate Waste in the National School Lunch Program. Identification of proximate causes of oversupply of NSLP food.

via salad bar (Adams et al., 2005). While findings from published research may show mixed results of plate waste, it has been noted that increased choices, and subsequently greater exposure of foods to students, may have positive impacts on customer satisfaction and students' nutrition education.

Increased exposure: While results have been mixed regarding consumption of fruits and vegetables with OVS, researchers have hypothesized that SO could actually reduce waste because of more frequent exposure (Birch & Marlin, 1982). More recently, school garden literature shows greater engagement by students with fruits and vegetables leads to increased consumption (Heim, Stang, & Ireland, 2009). While anecdotal evidence from practitioners clearly

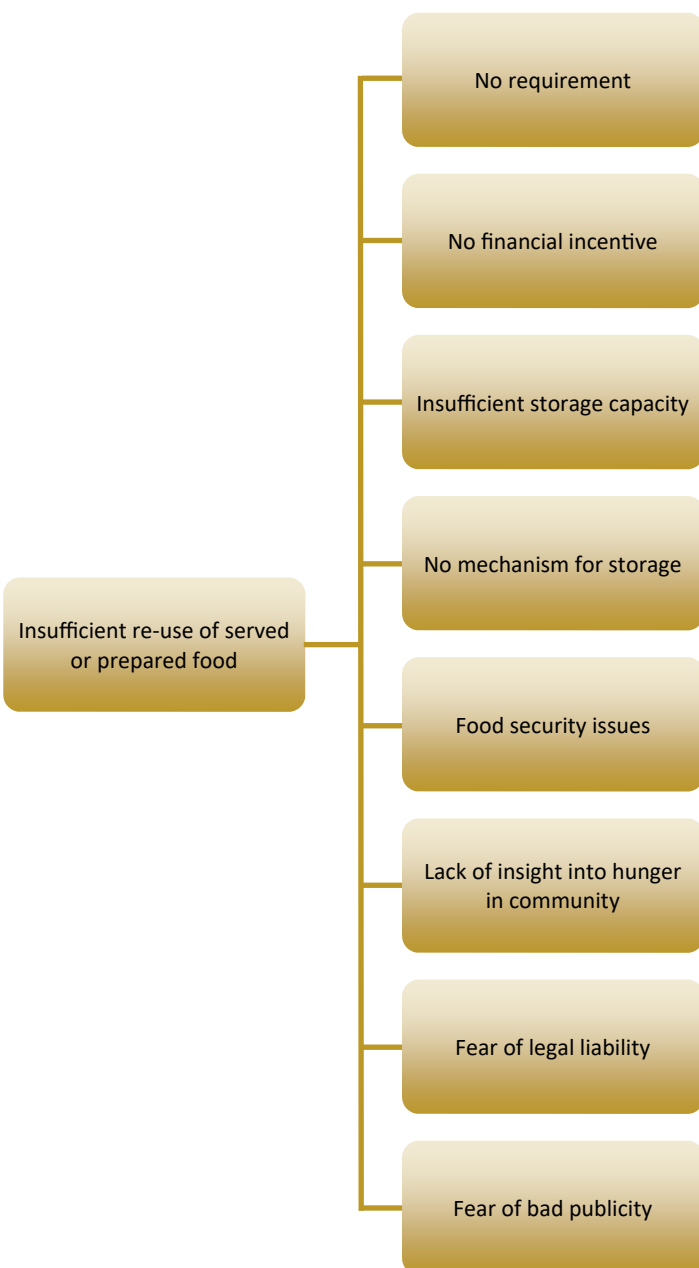


Figure 4. Insufficient Re-use of Plated and Served Food and Associated Causes of Plate Waste in the National School Lunch Program. Identification of proximate causes of insufficient re-use of plated and served NSLP food.

communicates the need to be patient with new menu offerings to allow students time to recognize and accept new foods, published research was not found in a review of the literature.

Fresh Fruits and Vegetables Program: The Fresh Fruit and Vegetable Pilot Program (FFVP) of 2002 was meant to encourage consumption of fresh fruits and vegetables through improved availability by subsidizing costs incurred by schools to purchase these foods. With a FFVP, fresh fruits and vegetables are served outside of normal NSLP and SBP service times. Reported availability of fresh fruits and vegetables to elementary schools through FFVP has been a success (Ohri-Vachaspati et al., 2012) but no plate waste statistics have been published. The increased availability and reported increased consumption have no known bearing on NSLP plate waste, although arguments could be made that it increases lunchtime plate waste (as expected availability of fresher fruits/vegetables later in the day results in less consumption at lunch) or that FFVP decreases plate waste (because increased exposure may improve kids' intake of fruits and vegetables in the NSLP context) (Birch & Marlin, 1982; Cullen et al., 2009; Heim et al., 2009).

Logistical Reforms: Infrastructure considerations, including but not limited to the amount of time children have to eat, time of day that lunch is served, and placement of recess in relation to the lunch period are thought to influence student consumption of NSLP food. Often, building administrators who may not be aware of resultant impact on plate waste make scheduling decisions regarding lunch periods.

Recess Before Lunch (RBL): Given the possibility that it *could potentially* decrease plate waste – and owing to prior data showing positive feedback from school teachers and administrators – recess before lunch (RBL) is considered best practice for its ability to decrease plate waste, increase consumption of school lunch, and calm lunchroom and afternoon classroom environments. However, it is important to note that different approaches to plate waste collection and measurement were used in these studies, which may explain variations in specific findings. Further, studies occurred in different geographic locations in which weather conditions may have affected appetites of students. The impact of environmental factors may also have affected results, as previously noted (Strohbehn et al., 2016).

Increasing Length of Lunch Period: No federal standards exist as to the length of time available to students for lunch although each state agency that administers the NSLP recommends suitable time periods. Findings from the School Nutrition Association's (SNA) *State of School Nutrition 2016* survey (School Nutrition Association, 2016), which included responses from nearly 1,000 SNA member school districts nationwide, showed a median lunch period of 25 minutes for elementary schools and 30 minutes for middle and high schools. Lunch periods also included travel time from the classroom to the cafeteria, handwashing stops, time spent in line to get a meal, and service or selection of meal items. Thus, actual times available for food and beverage consumption varied (Cohen et al., 2016). "Grab and go" options, meal bundles, vending machine dispensing, and a scramble system (component stations) rather than a single line of service have all been used successfully by innovative programs. Anecdotally, some school nutrition program directors have calculated the cost of food wasted due in part to limited time available to eat and provided building administrators with this information as they make their case for scheduling changes. Other logistical issues may relate to number of students and classes served in the building cafeteria, which in many schools is also used for other educational purposes such as gym class or music lessons. All of these issues require further study to measure their impact on plate waste.

Addressing Oversupply

In our literature search, we found no academic journal articles objectively measuring the effect of supply-sided changes to NSLP on plate waste. Control of amount of prepared product preparation through use of batch cooking or cooking to the line not only avoids overproduction of food items, but can lead to quality improvements. Thus, this is considered a best practice as forecasted production amounts are typically based on historical records and do not always account for scheduling changes (e.g. class field trips) or weather changes that might affect student selections.

Plate waste findings post-HHFKA have been mixed. One study (Schwartz et al., 2015) found no increases in plate waste whereas another (Byker, Pinard, Yaroch, & Serrano, 2013) showed increases in plate waste of vegetables, entrees, and milk. The increase in plate waste may be due to a required serving of either fruit or vegetable in order for the meal to be considered reimbursable. As noted, findings from plate waste studies can be influenced by a number of factors such as menu, weather, and other logistical considerations.

Addressing Insufficient Re-use

With concerns of plate waste in our society coupled with increasing numbers of individuals considered food insecure, there is attention to re-use of food that has been served (typically because of requirements to meet standards for a reimbursable meal), but uneaten. Food Code regulations specify which types of food and package forms can be re-served after first presented to customers; generally shelf stable packaged foods, such as individual packed condiments or snacks are allowed. Other considerations for NSLP pertain to social impacts on students; is there pressure to donate foods they have been served?

Donation Policy: The Federal Food Donation Act of 2008 required Federal Agencies with > \$25,000 in total purchases to make provisions encouraging contractors to donate excess apparently wholesome foods in all contracts ("Federal Food Donation Act 2008," 2008). While the Federal Food Donation Act of 2008 at present time does not apply to NSLP participants and does not occur at the State level, the existence of this policy demonstrates the role of government intervention. Reimbursement in the NSLP occurs on the basis of reimbursable meals *served*, not reimbursable meals (or reimbursable nutrients) *consumed*. Districts may be concerned regarding safety and resultant liability risk with food donations. Both perishable and non-perishable served items may be eligible for donations depending on local regulations. Donor liability is limited through the Bill Emerson Good Samaritan Food Donation Act of 1996 ("Conversion to Permanent Law of Model Good Samaritan Food Donation Act and Transfer of that Act to Child Nutrition Act of 1966," 1996). In short, the Act eliminates the civil and criminal liability arising from the nature, age, packaging, or condition of apparently wholesome food donated in good faith by a School Lunch Program to a nonprofit organization. Further efforts put in place by the EPA aim to reduce waste through the creation of non-financial awards for sustainable food management with its Food Recovery Challenge launched recently (2017).

Sharing Tables: The concept behind the Sharing Table is to have a dedicated cart or table on which students can place selected but unconsumed food or beverage items for use by other students at no charge. Concerns exist about the use of Sharing Tables including proper food handling and storage (addressing cross-contamination and temperature abuse concerns), over-selection from OVS arrangements for the purpose of donation, and allergen exposure (though limiting donation to prepackaged foods mitigates this risk).

No academic studies addressing effects of Sharing Tables on plate waste or total food waste were found in the literature. A recent USDA Child Nutrition Program memo released in June 2016 noted Sharing Tables was an innovative strategy to reduce plate waste but implementation was under jurisdiction of state and local health codes (USDA, 2016d). The memo stressed Sharing Table use was for purposes of addressing plate waste and reinforced for program administrators that frequent issues of plate waste should be addressed through better management practices of menu planning and production controls. The U.S. Food and Drug Administration issues a set of recommendations regarding safe food handling practices in the biannual Food Code. State and local health agencies use Food Code as guidance in establishing regulations. Food Code 2013 (and previous versions) allows re-service of shelf stable, unopened packaged foods and re-service of unopened Temperature Control for Safety foods, such as milk cartons, if product is kept at safe temperatures and time controls are monitored (FDA, 2013). Multiple handlings of food packages may present risks of viral illnesses. Thus, it is recommended health inspectors be involved in discussions about starting a Sharing Table at a school and clear guidance be provided at each building. In addition to food safety, other concerns have been noted related to students' motivations to donate. Students may over-purchase or over-self-serve foods in order to achieve a "feel good" return or be perceived as doing something good by a respected teacher or other role model, thus potentially increasing total food waste. Or, there may be subtle social pressure placed on students to share; if they do not students may feel at risk of being labeled selfish. USDA Food and Nutrition Service has many resources to assist district child nutrition program administrators and local school boards in policy development (USDA, 2017).

CONCLUSIONS AND APPLICATIONS

Plate waste in NSLP is a multifaceted problem. Use of an exploratory data collection approach called Root Cause Analysis provides an integrated view of the factors associated with the problem. In this paper, a wide array of strategies and potential policy interventions aimed at reducing NSLP plate waste has been presented. Most of plate waste research to date has focused on impacts of interventions aimed at increasing consumption, while those interventions aimed at promoting the re-use of prepared food have not been studied. As a result of this RCA, identification of potential pilot projects are presented in Table 1. Potential pilots could assess effectiveness of pre-ordering and/or pre-serving reimbursable components of meals to increase the amount of time available for consumption. Another pilot might abandon the traditional 'check out' line in favor of mobile checkout that occurs at the table while students eat.

Oversupply may continue to be problematic, as operators want to ensure customer satisfaction with availability of choices. Accurate record keeping is essential. Production records should include amounts forecasted, prepared, and served along with contextual data

Table 1. Potential Pilot Projects to Address Secondary Causes Associated with Root Cause of Oversupply.

Secondary Cause	Potential Pilot Project
Too much food ordered	<ul style="list-style-type: none">• Smart ordering systems• Staff training
Too much food prepared	<ul style="list-style-type: none">• Forecasting analysis• Batch cooking• Staff training
Over portioning at self-service	<ul style="list-style-type: none">• Classroom education about plate waste• Point of sale models• Adjustment of serving utensils• Classroom problem solving cost of waste

such as weather conditions, scheduled field trips or other information that may have affected supply and demand. Care should also be taken by school nutrition program administrators to incorporate ordering and forecasting methods that reflect local popularity indexes of menu choices that might result in less waste, recognizing other variables also affect consumption. A recent USDA Food and Nutrition Service (FNS) webinar offering guidance on the topic provided continuing education to program administrators (USDA, 2016c). Further, experimentation with smart ordering systems, real-time inventory analysis, and improved seasonally adjusted data collection and analysis methods aimed at reducing oversupply and freeing up physical space in the kitchen should be considered. Incorporation of batch cooking, or “just in time” preparation will result in higher quality products and capability to “cook to the line”.

With respect to re-use of food, the impact of Sharing Tables on plate waste and incorporation of donation policies into procurement processes are potential avenues forward. USDA (2016d) has begun the step of formalizing donation policy with the June 2016 memo about Sharing Tables; additional resources to educate all relevant stakeholders, including parents/guardians and students, into the benefits and proper processes of donations of prepared food as well as relief from legal liability may be helpful. The challenges with published studies on plate waste indicate the value of local data. To avoid some of difficulties noted such as labor-intensive weight-and volume-based collections of plate waste, less logistically disruptive technologies such as digital photography and analysis might be considered (Connors & Bednar, 2015). Research investigating actual costs of plate waste would be helpful information for nutrition program and school building administrators as this data may influence decisions related to meal timing or menus.

The problem of plate waste is complicated as it encompasses environmental and social issues. Is the problem of plate waste within the NSLP large enough to justify the costs of solving it, given that some degree of food waste is to be expected (Buzby & Guthrie, 2002)? Given the mission of NSLP is to provide safe and nutritious food to children and that the program operates within an educational setting preparing students of today to become productive members of society, the argument could be made that addressing the problem of plate waste is justified. This analysis of plate waste in the NSLP identified multiple root causes of the problem, some of which have previously been studied as well as others that have not.

In this study, we show that RCA is a useful tool for educators and practitioners (current and future) in addressing issues of concern, in this case the problem of plate waste. Instructors in foodservice management programs may consider use of RCA to explore other multi-faceted problems, such as employee turnover, or gaps between employee training and practices. Small groups of students could conduct an RCA, develop flow charts, discuss identified clusters based on class lectures and review of literature, and propose action steps or policy interventions, similar to the pilot projects identified in Table 1. The use of RCA in the classroom can challenge students’ critical thinking and evaluation skills and lead to creation of original work.

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