

The Development of Dietary Intake Monitoring System (DIMS) and application in a Hospital Setting

Effect of meal portion size choice on plate waste generation among patients with different levels of nutritional status .

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Introduction

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25 % of
patients are
malnourished

Enough food
for all
patients

Up to 50%
Food is
wasted

Mortality.

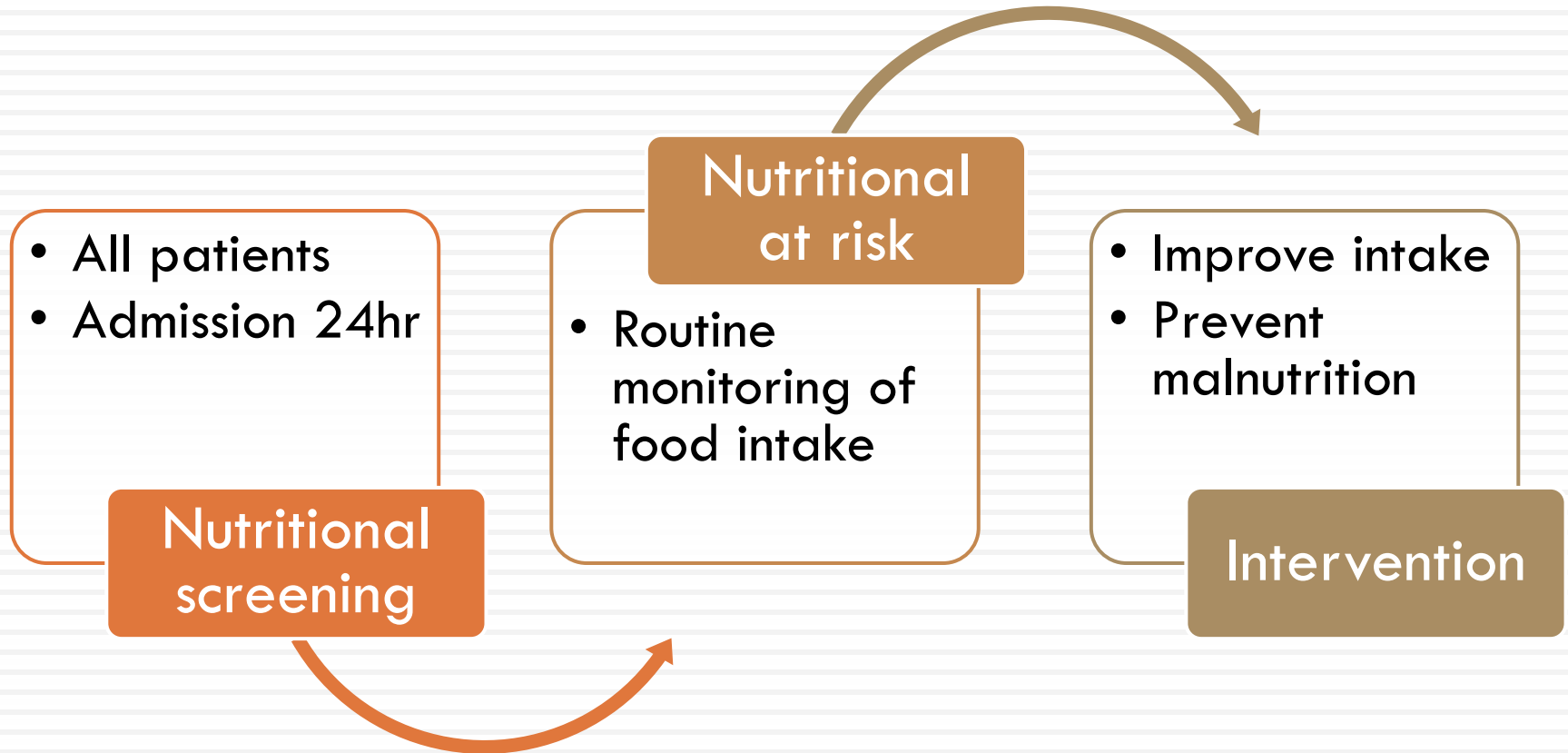
Prolong
length of
stay

Increase
health cost



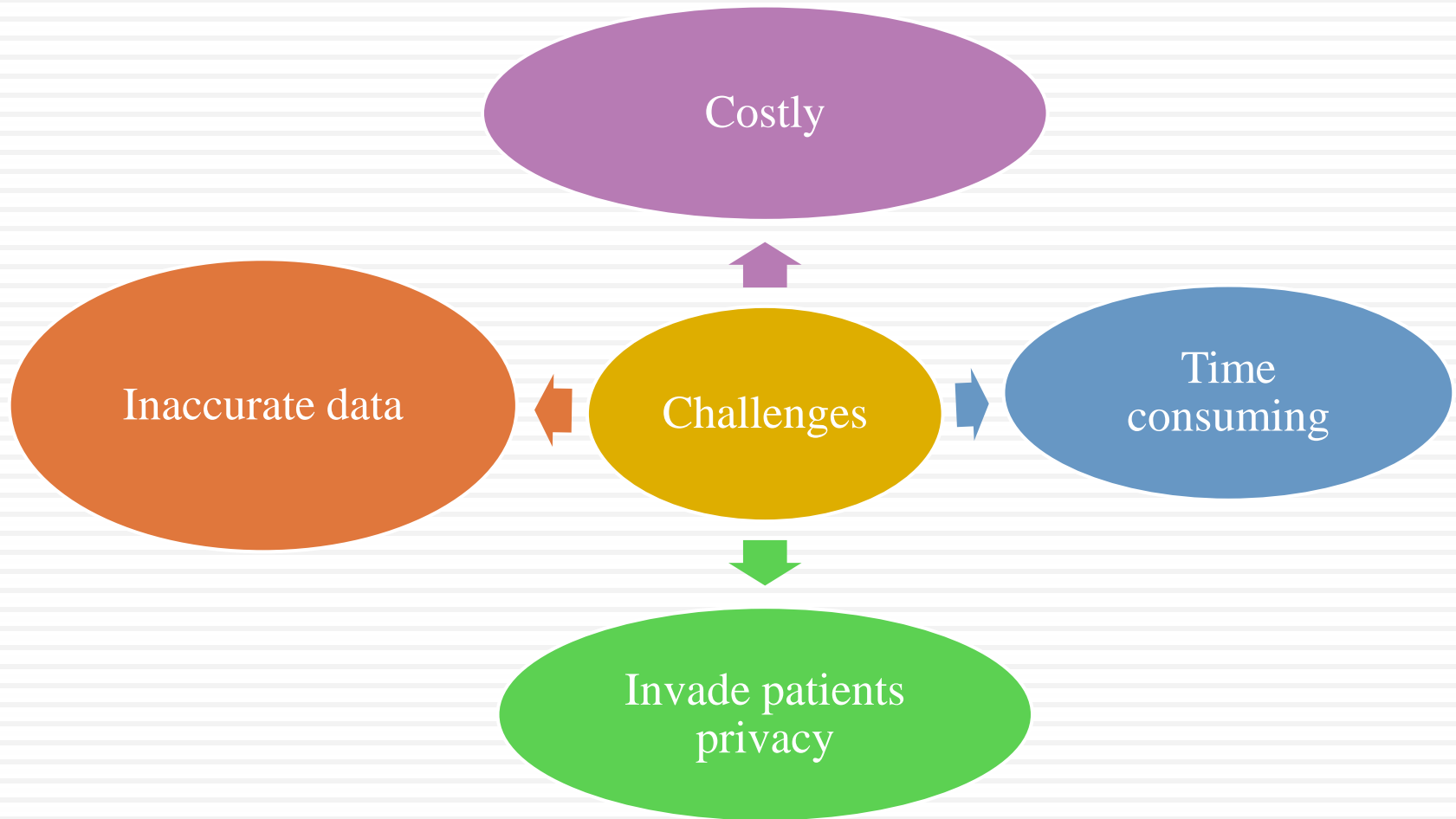
Inadequate Routine monitoring of Dietary Intake in a hospital setting

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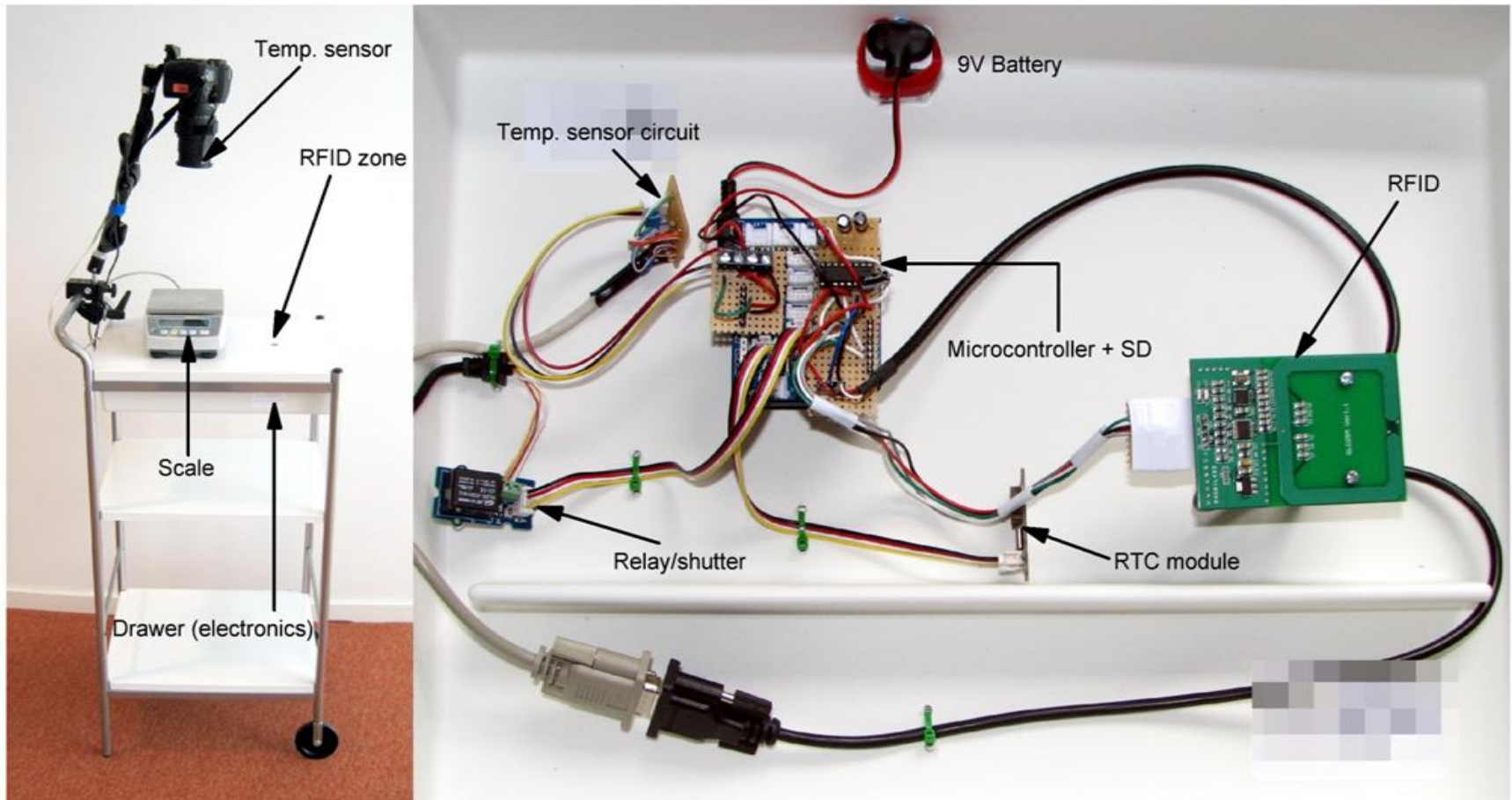
Challenges with the current Tools/methods

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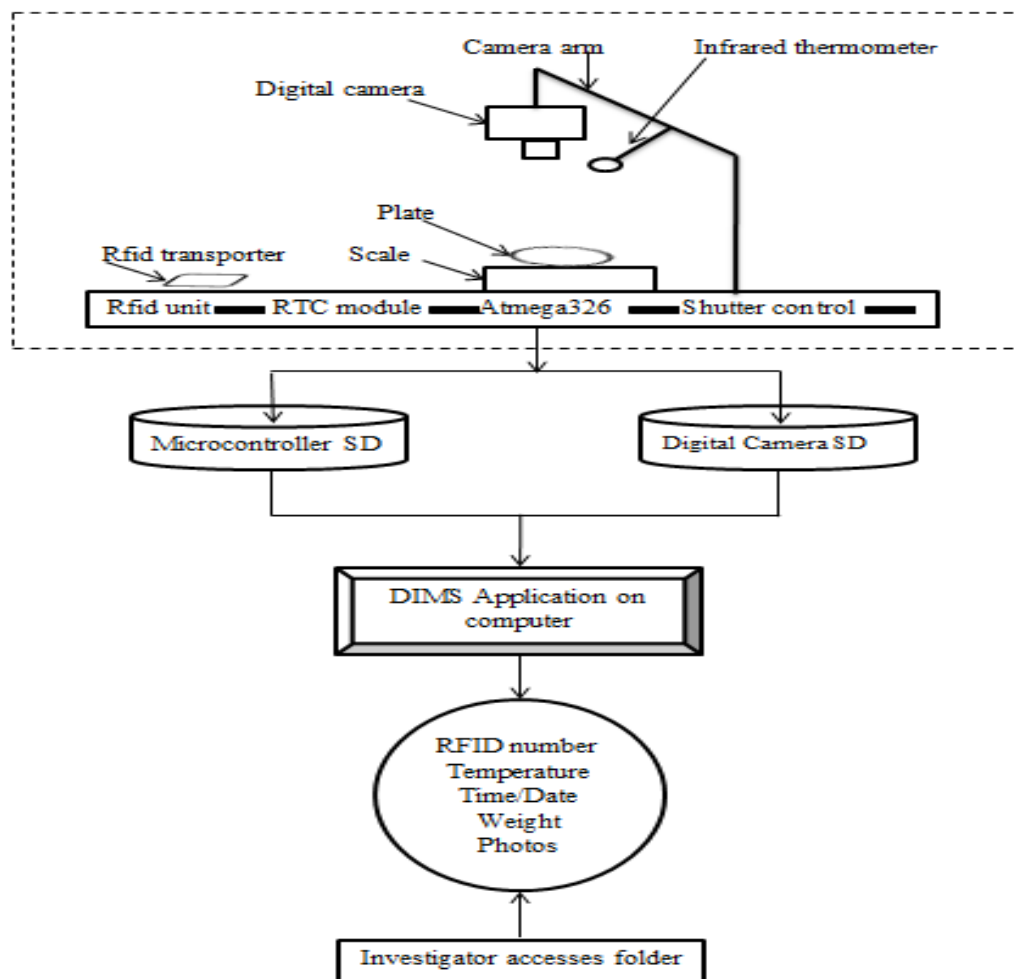
The Development of DIMS Prototype: Solution to routine monitoring

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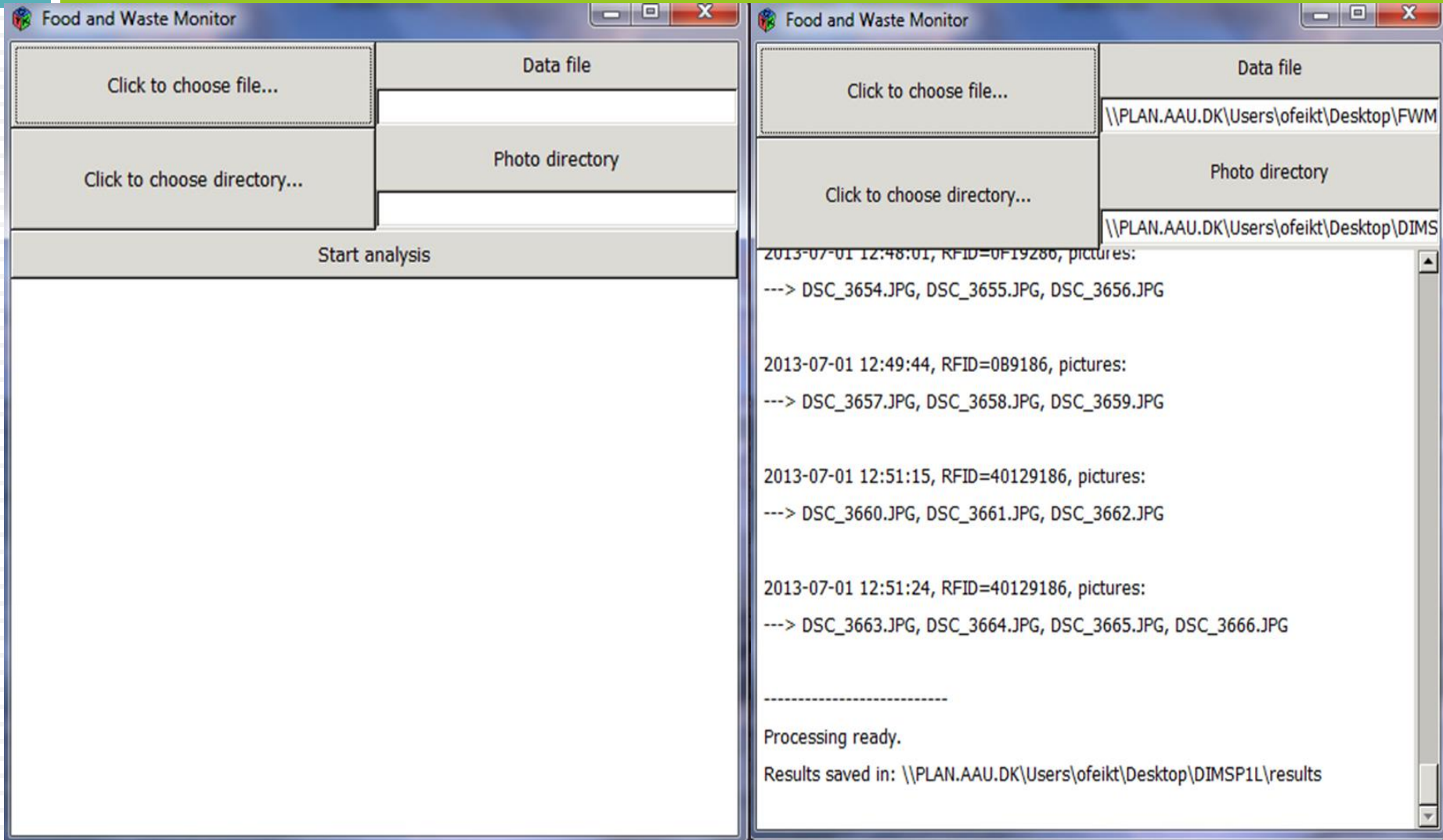
DIMS for collecting paired before-and after-meal consumption photos and measure the weight of plate content.

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DIMS analyser

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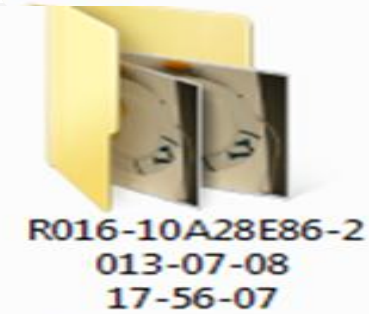
Output from food intake and plate waste analyser

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 R001-E04A9386-2013-07-01 10-48-06 File folder	 R002-E04A9386-2013-07-01 10-48-28 File folder	 R003-E04A9386-2013-07-01 10-49-39 File folder	 R004-E04A9386-2013-07-01 10-50-01 File folder
 R005-E04A9386-2013-07-01 12-04-35 File folder	 R006-70D08E86-2013-07-01 12-08-29 File folder	 R007-70D08E86-2013-07-01 12-08-47 File folder	 R008-20569386-2013-07-01 12-09-31 File folder
 R009-20569386-2013-07-01 12-10-13 File folder	 R010-C0B39286-2013-07-01 12-10-48 File folder	 R011-C0B39286-2013-07-01 12-11-03 File folder	 R012-30549386-2013-07-01 12-11-37 File folder
 R013-30549386-2013-07-01 12-11-59 File folder	 R014-0F19286-2013-07-01 12-12-42 File folder	 R015-80B69286-2013-07-01 12-13-35 File folder	 R016-80B69286-2013-07-01 12-13-44 File folder
 R017-704D9286-2013-07-01 12-14-26 File folder	 R018-40489286-2013-07-01 12-15-32 File folder	 R019-E0179186-2013-07-01 12-17-21 File folder	 R020-40FA9286-2013-07-01 12-18-17 File folder
 R021-40FA9286-2013-07-01 12-19-13 File folder	 R022-A0CA9186-2013-07-01 12-20-16 File folder	 R023-A0CA9186-2013-07-01 12-20-27 File folder	 R024-0B9186-2013-07-01 12-20-56 File folder
 R025-C0489286-2013-07-01 12-21-46 File folder	 R026-C0489286-2013-07-01 12-22-19 File folder	 R027-30549386-2013-07-01 12-26-45 File folder	 R028-30549386-2013-07-01 12-26-59 File folder
 R029-30549386-2013-07-01 12-27-15 File folder	 R030-40129186-2013-07-01 12-27-33 File folder	 R031-40129186-2013-07-01 12-27-53 File folder	 R032-704D9286-2013-07-01 12-29-00 File folder
 R033-902A9386-2013-07-01 12-29-32 File folder	 R034-902A9386-2013-07-01 12-29-41 File folder	 R035-A02E9386-2013-07-01 12-30-26 File folder	 R036-A02E9386-2013-07-01 12-31-14 File folder
 R037-40FA9286-2013-07-01	 R038-40FA9286-2013-07-01	 R039-C0B39286-2013-07-01	 R040-C0B39286-2013-07-01

Measurement of before and after plate content and weight

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Patient ID	Weight Before/g	Weight After/g	Food Intake/g	Plate waste/g
50479286	638 -413= (225)	532-413= (119)	106	119 (52.89)
10A28E86	502-413 = (89)	413-413=(0)	89	0

Shows patient's food choice, plate waste, food intake and the temperature of food before consumption.

RFID code	Food items on plate before consumption (total food items)	Total food weight before consumption (g)	Temperature of food before consumption (C°)	Food items on plate after consumption (total food items)	Total food weight after consumption (g)	Plate waste (%)	Total food intake (g)	Total food intake (%)
a0789086	GH,MP, PO (3)	441	23,6	GH,MP,PO (3)	122	27,6	319	72,3
10a28e86	GH,MP,PO,AC (4)	358	24,0	(0)	0	0	358	100
90b59286	GH,MP,PO (3)	274	23,2	GH,PO (2)	54	19,7	220	80,3
80509386	GH,PO,PS (3)	379	23,1	PO,PS (2)	91	24,0	288	75,9
c0dc8e86	MG,PR,MY,BT,BP(5)	296	24,0	(0)	23	7,8	273	92,2
602b9086	FH,MP,HS,BT,BP(5)	430	23,3	(0)	0	0	430	100
c0279386	MG, PR,BP,MY(4)	202	23,8	MG,PR,BP,MY(4)	146	72,2	56	27,7
a0b49286	FH, PR,HS (3)	206	23,7	(0)	0	0	206	100
e0399386	FH, MP, HS,BT(4)	265	24,6	(0)	0	0	265	100
40ba9286	MG,PR,BP,BT,MY(5)	256	23,1	MG,PR,BP,BT,MY(5)	208	81,3	48	18,6
20f08f86	FH,MP,BU (3)	272	24,3	FH,MP(2)	157	57,7	115	42,3
a00d9186	FH,RP,HS,BT(4)	178	23,9	FH,RP,HS,BT(4)	160	89,9	18	10,1
e0be9286	MG,MP(2)	112	23,5	(0)	0	0	112	100
60b79286	MP,CC(2)	265	24,5	CC(1)	38	14,3	227	85,7
50319386	FC,MP,WS(3)	193	25,0	WS(1)	30	15,5	163	84,5
c04c9386	FC, MP,WS,CS(4)	270	26,2	(0)	0	0	270	100
d04c9386	FC, MP,WS,LJ(4)	302	25,7	(0)	0	0	302	100
80eb8f86	FC,MP,WS(3)	329	23,8	WS(1)	20	6,1	309	93,9
604e9286	FC, MP,WS,CS(4)	310	26,3	FC, MP,WS,CS(4)	244	78,7	66	21,3
504f9286	FC, MP,WS,CS,LJ(5)	264	24,3	FC, MP,WS,CS,LJ(5)	245	92,8	19	7,2
c0009386	FC,PP,WS,CS(4)	322	24,2	FC,PP,WS,CS(4)	117	36,3	205	63,7
20d98e86	FH,MP,CS,BU(4)	318	24,7	FH,MP,CS,BU(4)	132	41,5	186	58,5
904b9387	FC,MP,WS(3)	267	24,8	(0)	0	0	263	100
Mean	(4)	283	24,2	(2)	78	27,5	205	72,5

Application of DIMS in Hospital Setting Study

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This study therefore examined:

- the portion size served, consumed and plate waste generated in relation to a patient's nutritional status;
- the extent to which the size of meal portions served and consumed contributed to a patient's daily recommended intake for energy and protein;
- the predictive effect of the meal portion sizes served on plate waste generation; and
- the applicability of a dietary intake monitoring system (DIMS) as a technique for monitoring plate waste in a hospital.

Table 1. Characteristics of study participants by nutritional risk status

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- A total of 256 meals (142 lunch and 114 supper meals)
- 71 patients admitted over a 5 day duration

Variable	Mean \pm SD	Not At risk n=24	At risk n=47	<i>p</i> -value
Female		12 (50%)	26 (55%)	0.671
Male		12 (50%)	21 (45%)	
Age (year)	65.6 \pm 13.5	66.4 \pm 11.1	62.9 \pm 15.2	0.322
BMI (kg/m ²)	24.6 \pm 5.7	26.1 \pm 4.2	23.8 \pm 6.4	0.155

Table 2 Median meal portion size served, consumed and wasted by patients according to nutritional risk status

Nutritional risk status	Lunch								
	Portion served (g)	Portion consumed (g)	Portion wasted (g)	Energy served (KJ)	Energy consumed (KJ)	Energy wasted (KJ)	Protein served (g)	Protein consumed (g)	Protein wasted (g)
All patients	250 (178-323)	205 (126-294)	29 (3-86)	1123 (684-1686)	843 (471-1397)	108 (4-426)	10 (6-17)	8 (3-14)	1 (0-3)
Not at risk	271 (197-356)	239 (150-302)	21 (3-58)	1201 (807-1709)	990 (517-1567)	72 (0,0-386)	13 (7-18)	9 (5-15)	1 (0-3)
At risk	235 (169-311)	185 (113-292)	32 (3-96)	1003 (612-1591)	741 (358-1234)	150 (8-427)	8 (4-15)	6 (2-14)	1 (0-4)
P-value	0.060	0.061	0.433	0.047	0.052	0.229	0.020	0.027	0.315
	Supper								
All patients	293 (202-396)	225 (127-315)	48 (8-133)	1352 (980-2002)	998 (584-1654)	226 (20-691)	16 (10-25)	11 (6-19)	2 (0-7)
Not at risk	308 (197-404)	267 (162-330)	23 (0-61)	1367 (1005- 1922)	1126 (750-1814)	93 (0-311)	16 (10-26)	13 (7-22)	1 (0-3)
At risk	284 (203-393)	189 (115-288)	88 (20-146)	1223 (949-2430)	809 (482-1454)	472 (112-795)	17 (10-26)	10 (7-19)	3 (1-9)
P- value	0.955	0.032	0.001	0.825	0.032	0.001	0.579	0.327	0.002

□ Data are presented as Median (interquartile ranges) Mann-Whitney U test for P-value

Table 3 Portions served, consumed and wasted as a percentage of total daily recommended intakes in relation to nutritional risk status

Nutritional risk status	% Energy served	% Energy consumed	% Energy wasted	% Protein served	% Protein consumed	% Protein wasted
Lunch						
All patients	13(9-19)	10(6-17)	1(0-4)	11(7-19)	9(4-15)	1(0-4)
Not at risk	14(10-19)	11(6-17)	1(0-4)	13(8-19)	11(5-19)	1(0-3)
At risk	12(8-19)	9(4-16)	2(0-5)	10(5-18)	8(3-15)	1(0-5)
<i>P- value</i>	0.230	0.150	0.330	0.136	0.09	0.37
Supper						
All patients	17 (12-24)	12 (7-20)	3 (0-9)	19 (11-29)	13 (7-22)	2 (0-9)
Not at risk	17(12-23)	13(9-19)	1(0-4)	18(11-26)	15(8-22)	1(0-4)
At risk	17(12-31)	10(6-21)	6(2-10)	21(11-30)	12(5-23)	3(1-10)
<i>P-value</i>	0.564	0.143	0.001	0.164	0.698	0.001

Data are presented as Median (interquartile ranges) Mann-Whitney U test for P-value

Table 4. Linear mixed model predicting plate waste (squared root transformed) from meal portion size served to patients of different nutritional risk status

Plate waste (Both lunch and supper)						
Parameter	Estimate	SE	<i>t</i> - value	<i>p</i> -value	95 % CI	
Intercept	4.275	0.841	5.071	0.001	2.612	5.939
Meal portion size	0.008	0.003	3.186	0.002	0.003	0.013
Not at risk	-1.451	0.827	-1.752	0.086	-3.114	0.211
At risk	<i>Referent</i>					
Lunch Plate waste						
Parameter	Estimate	SE	<i>t</i> - value	<i>p</i> -value	95 % CI	
Intercept	5.662	0.996	5.684	0.001	3.688	7.635
Meal portion size	0.000	0.004	-0.101	0.920	-0.007	0.007
Not at risk	-0.466	0.840	-0.554	0.581	-2.148	1.216
At risk	<i>Referent</i>					
Supper plate waste						
Parameter	Estimate	SE	<i>t</i> - value	<i>p</i> - value	95 % CI	
Intercept	5.689	1.246	4.566	0.001	3.218	8.161
Meal portion size	0.008	0.004	2.341	0.021	0.001	0.015
Not at risk	-3.328	0.960	-3.468	0.001	-5.279	-1.371
At risk	<i>Referent</i>					

Conclusion

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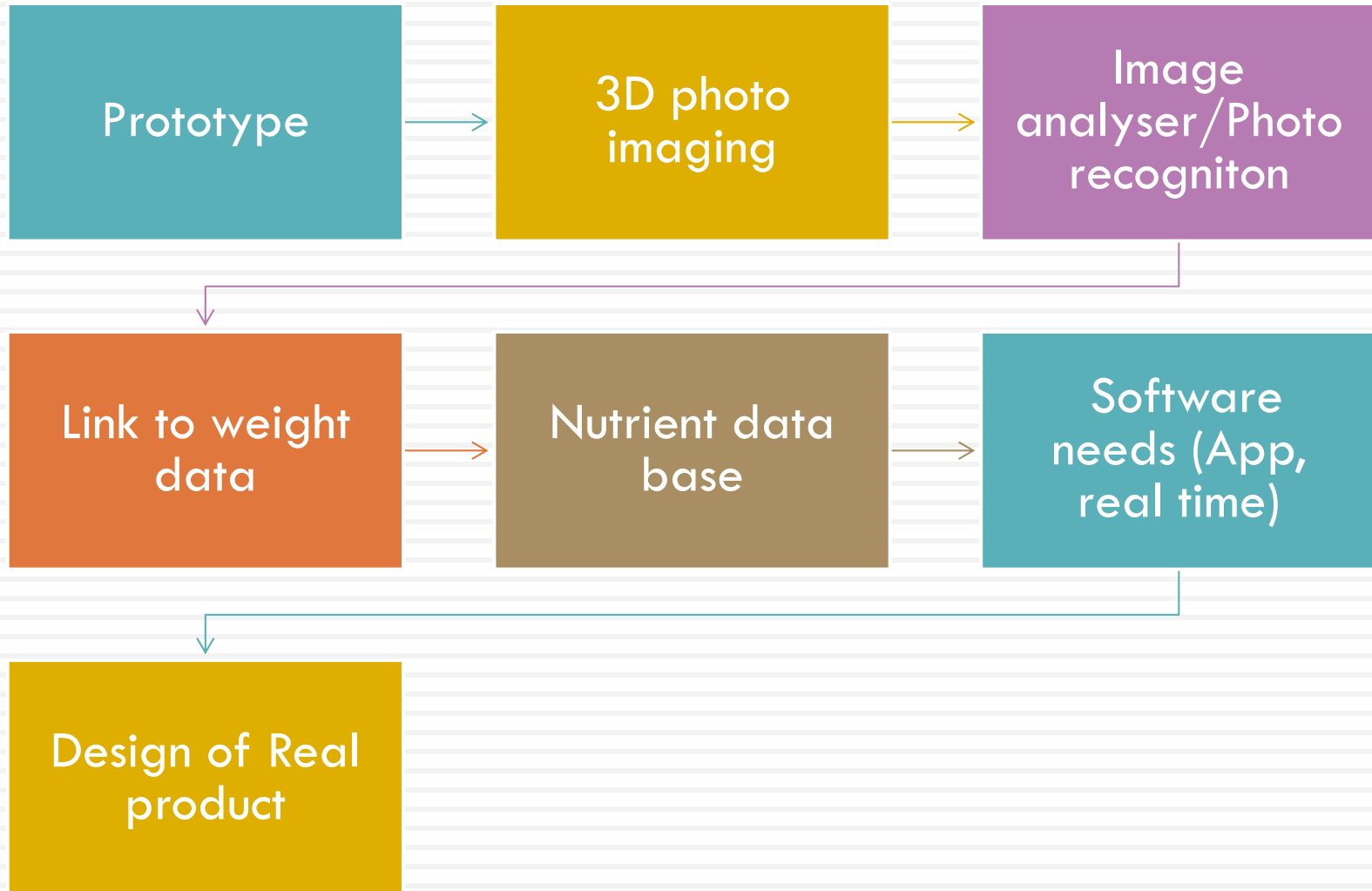
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- Meal portion size was associated with the level of plate waste produced.

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- Being at nutritional risk further increased the extent of waste, regardless of the portion size served at supper.

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- DIMS as an innovative technique might be a promising way to monitor plate waste for optimizing meal portion size servings and minimizing food waste

Further development from Prototype- to Automated DIMS

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Thank You!!!!!!

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Research Team

- Prof Bent Mikkelsen, (*MENU research Aalborg University*)
- Prof Henrik Højgaard Rasmussen (*Aalborg University Hospital*)
- Mette Holst: (*Aalborg University Hospital*)
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