Understanding end-of-life multimorbidity: An analysis of Multiple Causes of Death in Denmark

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Background: Challenges of mortality analysis

→Death involves numerous health risks and diseases throughout the lifespan

→Traditional mortality analysis focuses on single underlying cause of death

→This approach misses the complex morbidity process leading to death

→Misreporting or misclassification of underlying cause is a persistent issue (Bishop et al., 2023)

Background: Growing Complexity of Mortality

→Average number of contributing causes has been increasing over time (Cheng et al., 2012; Jetté et al., 2010)

→Older individuals typically present more complex combinations of causes

→When multiple conditions interact, determining a single cause becomes problematic

- →Need for data and methods that capture multimorbidity at end of life

Background: Multiple Causes of Death (MCoD)

→MCoD analysis provides a more comprehensive view of mortality (Janssen, 1940):

- →Records all conditions that contributed to an individual's death
- →Provides insights into mortality risks and interactions
- →Highlights chronic conditions often relegated to secondary roles

→**MCoD data are subject to biases: misreporting, underreporting, etc.**

1. Are the MCoD data representative of end of life health conditions?

NO!

2. Do they better represent the chain of events leading to death?

MAYBE!

Data: Danish registers

→**Cause of death register**

→Including all information on leading cause of death, contributing causes, and co-causes

→**Register of chronic diseases**

→Including individuals <u>diagnosed</u> with: COPD, dementia, and diabetes

Data: Study population

Danish population diagnosed with a <u>chronic condition</u> from 2010 who are at least 50 years old:

→Sex
→Birth date
→Date (and age) at diagnosis
→Date (and age) at death
→Cause of death (1.a-1.d, 2.1-2.4)

Methods: Descriptive analysis

Exploratory analysis to investigate:

→Number of times (%) each chronic disease appears on the death certificate (in any position), both for the whole study population and only for those with 1 year elapsed between diagnosis and death

→Location of the chronic disease on the death certificate (%), for those who have the chronic disease on the death certificate

→Number of deaths (%) by causes of death, for those who have the chronic disease on the death certificate

Methods: Multiple decrement life tables

Multiple decrement life tables computed by:

$$_nq_x^i = {}_nq_x * \frac{_nD_x^i}{_nD_x}$$

$$_nd_x^i = {}_nq_x^i * l_x$$

$$ratio_x^i = \frac{\sum_x {}_nd_x^i}{\sum_i \sum_x {}_nd_x^i}$$

→Sex

→Period: 2010-2014 and 2015-2019

→Chronic disease: COPD, dementia, and diabetes

→Cause of death: Human Cause of Death Database (HCD), 17 categories

RESULTS:

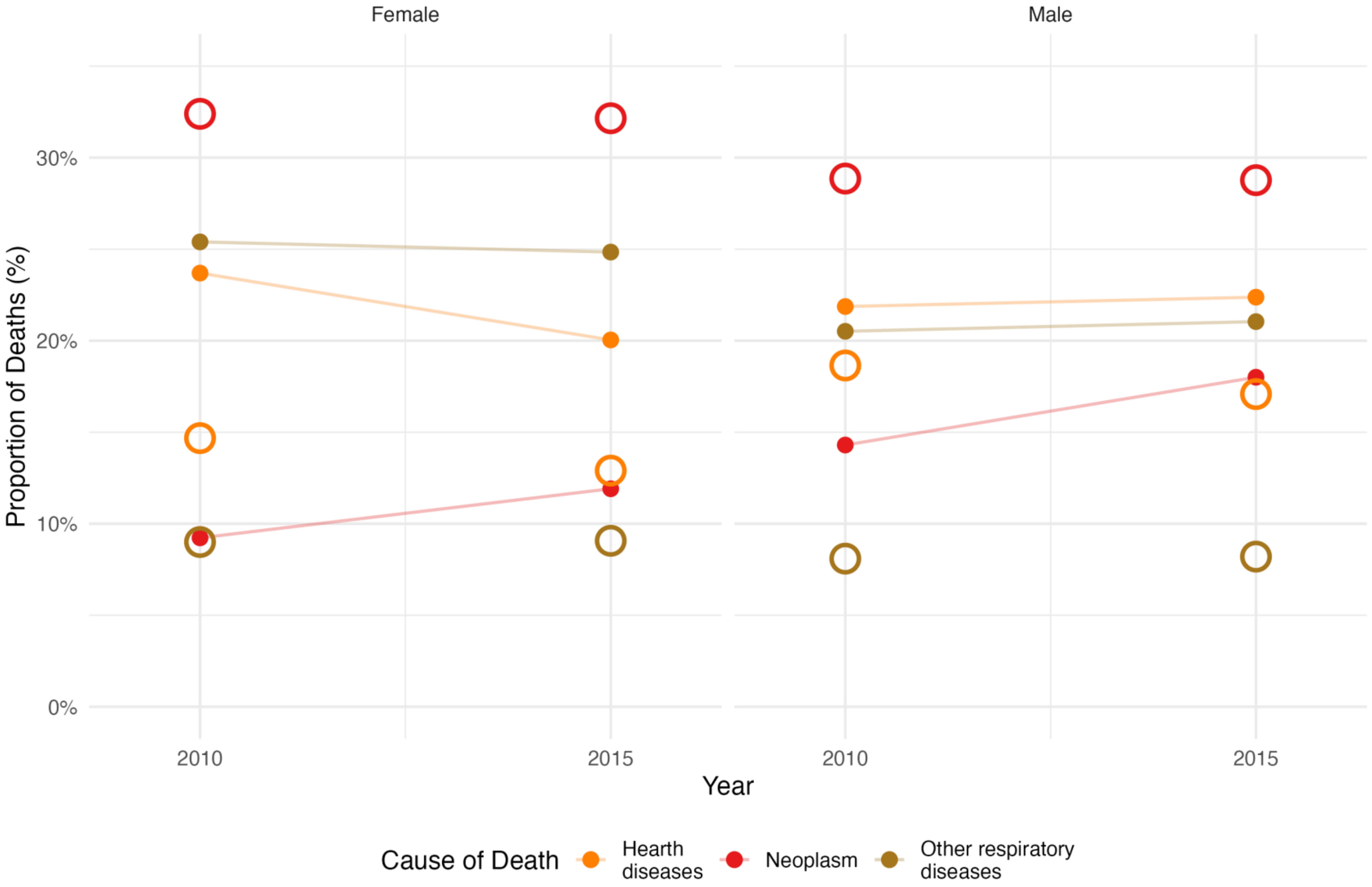
COPD

Descriptive results COPD - I

Total study population			Subsample of those died within a year from diagnosis		
Has COPD	**n**	**%**	**Has COPD**	**n**	**%**
FALSE	15739	64,9	FALSE	4639	69,4
TRUE	**8496**	**35,1**	**TRUE**	**2050**	**30,6**

Placement on death certificate	**n**	**%**	**Placement on death certificate**	**n**	**%**
1.a	645	7,6	1.a	114	5,6
1.b	1347	15,9	1.b	370	18,0
1.c	518	6,1	1.c	145	7,1
1.d	1488	17,5	1.d	323	15,8
2.1	2929	34,5	2.1	695	33,9
2.2	1075	12,7	2.2	287	14,0
2.3	356	4,2	2.3	81	4,0
2.4	133	1,6	2.4	35	1,7

Proportion of deaths among those with COPD by three leading causes of death, sex, year



Descriptive results COPD - II

Among those with CoPD somewhere in the death certificate			
CoD group	**CoD name**	**n**	**%**
1	Infectious diseases	91	18,6
2	**Neoplasm**	**1485**	**19,7**
3	Diseases of blood	22	23,9
4	Endocrine diseases	159	25,2
5	Mental disorders	104	16,6
6	Nervous system diseases	80	16,4
7	**Hearth diseases**	**1115**	**29,7**
8	Cerebrovascular diseases	205	18,9
9	Other circulatory diseases	116	23,1
10	Acute respiratory diseases	19	2,3
11	**Other respiratory diseases**	**4562**	**87,4**
12	Digestive system diseases	285	28,1
13	Skin and musculoskeletal diseases	43	23,5
14	Genitourinary and precnancy diseases	97	23,7
15	Perinatal and congenital	8	40,0
16	External causes	105	26,4
17	Ill-defined causes	.	.

RESULTS:

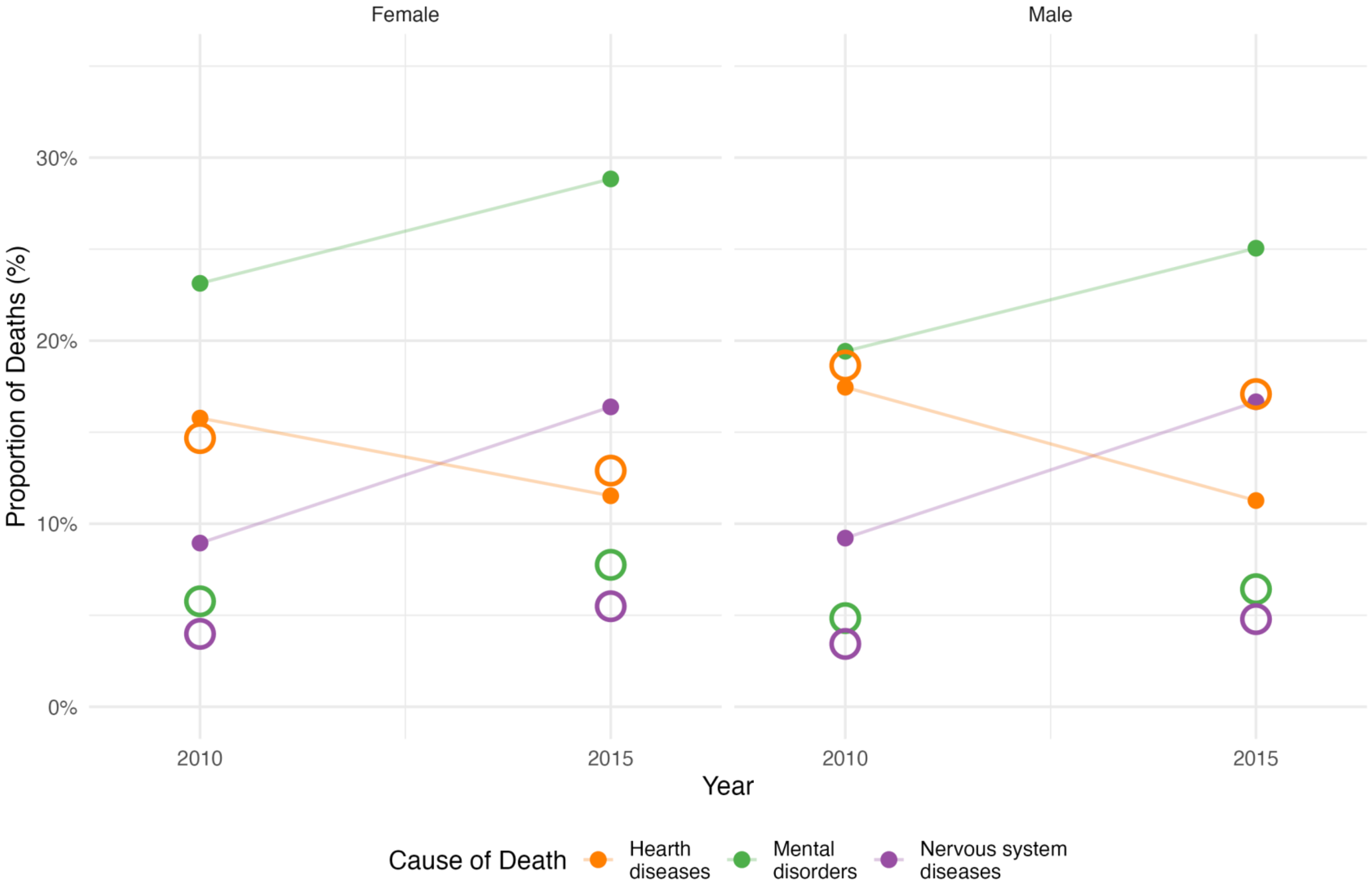
DEMENTIA

Descriptive results dementia - I

Total study population			Subsample of those died within a year from diagnosis		
Has dementia	**n**	**%**	**Has dementia**	**n**	**%**
FALSE	20054	44,8	FALSE	7590	59,3
TRUE	**24665**	**55,2**	**TRUE**	**5207**	**40,7**

Placement on death certificate	n	%	Placement on death certificate	n	%
1.a	5323	21,6	1.a	759	14,6
1.b	2694	10,9	1.b	482	9,3
1.c	779	3,2	1.c	166	3,2
1.d	3776	15,3	1.d	615	11,8
2.1	8752	35,5	2.1	2152	41,3
2.2	2300	9,3	2.2	696	13,4
2.3	745	3,0	2.3	238	4,6
2.4	271	1,1	2.4	92	1,8

Proportion of deaths among those with dementia by three leading causes of death, sex, year



Descriptive results dementia - II

Among those with dementia somewhere in the death certificate			
CoD group	**CoD name**	**n**	**%**
1	Infectious diseases	263	28,6
2	Neoplasm	1598	34,8
3	Diseases of blood	51	31,7
4	Endocrine diseases	446	34,9
5	**Mental disorders**	**10480**	**98,3**
6	**Nervous system diseases**	**5944**	**84,0**
7	**Hearth diseases**	**2111**	**39,6**
8	Cerebrovascular diseases	1387	39,4
9	Other circulatory diseases	175	35,9
10	Acute respiratory diseases	95	5,2
11	Other respiratory diseases	883	34,0
12	Digestive system diseases	435	34,0
13	Skin and musculoskeletal diseases	85	32,7
14	Genitourinary and precnancy diseases	146	18,9
15	Perinatal and congenital	48	50,0
16	External causes	514	48,2
17	Ill-defined causes	4	0,1

RESULTS:

DIABETES

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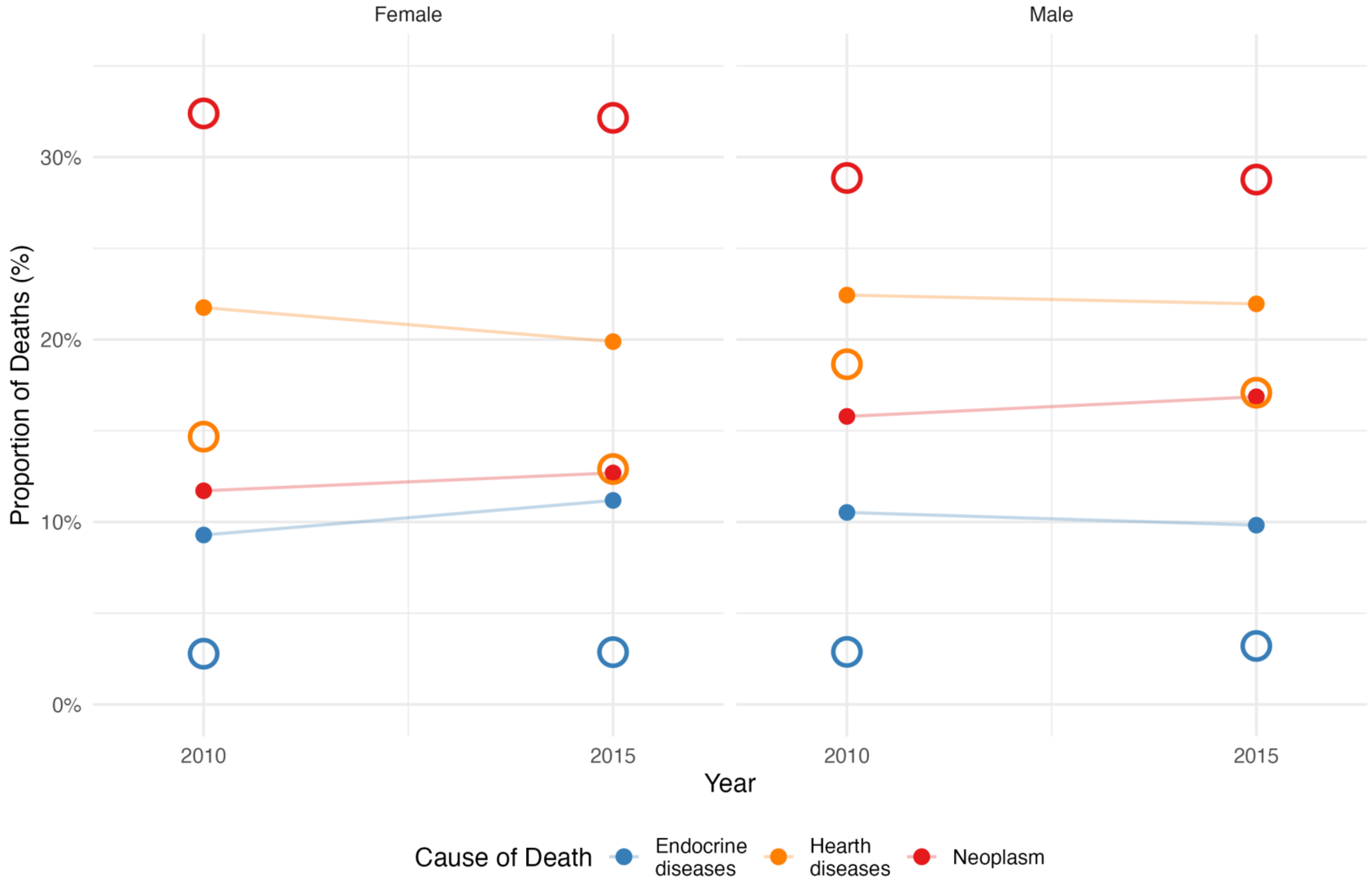
Descriptive results diabetes - I

Total study population			Subsample of those died within a year from diagnosis		
Has diabetes	**n**	**%**	**Has diabetes**	**n**	**%**
FALSE	17381	85,9	FALSE	3340	86,8
TRUE	**2855**	**14,1**	**TRUE**	**507**	**13,2**

Placement on death certificate	n	%	Placement on death certificate	n	%
1.a	6	0,2	1.a	15	3,0
1.b	62	2,2	1.b	13	2,6
1.c	72	2,5	1.c	16	3,2
1.d	111	3,9	1.d	243	47,9
2.1	1287	45,1	2.1	146	28,8
2.2	866	30,4	2.2	60	11,8
2.3	359	12,6	2.3	14	2,8
2.4	90	3,2	2.4	.	.

Proportion of deaths among those with diabetes by three leading causes of death, sex, year



Descriptive results diabetes - II

Among those with diabetes somewhere in the death certificate			
CoD group	**CoD name**	**n**	**%**
1	Infectious diseases	51	11,1
2	**Neoplasm**	**679**	**9,5**
3	Diseases of blood	16	18,2
4	**Endocrine diseases**	**498**	**36,7**
5	Mental disorders	102	12,8
6	Nervous system diseases	81	13,3
7	**Hearth diseases**	**544**	**17,0**
8	Cerebrovascular diseases	179	15,6
9	Other circulatory diseases	49	15,2
10	Acute respiratory diseases	70	11,7
11	Other respiratory diseases	321	16,6
12	Digestive system diseases	154	16,3
13	Skin and musculoskeletal diseases	15	12,3
14	Genitourinary and precnancy diseases	46	15,3
15	Perinatal and congenital	4	20,0
16	External causes	46	12,9
17	Ill-defined causes	.	.

DISCUSSION

Discussion: Preliminary results

- →**MCoD data cannot be used as proxy of individual’s health conditions at the end of life**
  - →At most half of the times (dementia) the chronic disease appears somewhere in the death certificate

- →**MCoD seem to be suitable for better understanding the chain of events leading to death**
  - →Looking at specific causes of death, associated with the chronic disease, it seems that the appearance rate is much higher
  - →This is however not the case for diabetes

Discussion: Next steps

→Investigate empirically whether age at diagnosis, age at death, time between diagnosis and death, cause of death (…) influence whether the chronic disease appears on the death certificate and where

→Look deeper into the MDLT results: 1 or 2-year time intervals instead of 5, compute confidence intervals

→Analyze cancer data and hospitalizations caused by health shocks (e.g., strokes)

Thank you for attention!

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