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Criminal Behaviour After Diagnosis of a Neurocognitive Disorder: A Nationwide Finnish Register Study

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ABSTRACT

Objective: *To explore criminal behavior of individuals with Alzheimer's disease (AD), frontotemporal dementia (FTD), or Lewy body dementias (LBD) after the diagnosis.* ***Design:*** *Nationwide register study.* ***Setting:*** *Information on diagnoses and criminality was received from Finnish registers. Crime types and incidences were compared between disorders and the general population.* ***Participants:*** *All Finnish individuals diagnosed with AD, LBD, or FTD (n = 92 189) during 1998–2015.* ***Measurements:*** *Types of crimes and incidences, the standardized criminality ratio (SCR, number of actual crimes per number of expected crimes), numbers of observed cases, and person-years at risk counted in 5-year age groups and for both sexes and yearly.* ***Results:*** *Among men, at least one crime was committed by 2.8% of AD, 7.2% of FTD, and 4.8% of LBD patients. Among women, the corresponding figures were 0.4%, 2.0%, and 2.1%. The most frequent type of crime was traffic offence, followed by property crime. After age adjustment, the relative number of crimes between groups did not differ, except that men with FTD and LBD committed more crimes than those with AD. The SCR (95% CI) among men were 0.40 (0.38–0.42) in AD, 0.45 (0.33–0.60) in FTD, and 0.52 (0.48–0.56) in LBD. Among women, these were 0.34 (0.30–0.38), 0.68 (0.39–1.09), and 0.59 (0.51–0.68).* ***Conclusions:*** *The diagnosis of a neurocognitive disorder does not increase criminal behavior, but rather reduces it by up to 50%. Differences in crime activity are present between different neurocognitive disorders and between the sexes.* (Am J Geriatr Psychiatry 2023; ■■:■■–■■)

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Highlights

- *What is the primary question addressed by this study?* Do patients with neurocognitive disorders commit crimes after they have received a dementia diagnosis?
- *What is the main finding of this study?* In our large nationwide Finnish register study, the crime rates were lower in the patient groups of Alzheimer's disease (AD), frontotemporal dementia (FTD) and Lewy body dementias (LBD) than in the same-aged general population, except in the group of FTD women. In comparison between the different neurocognitive groups, we found the highest crime rates in the LBD and FTD groups and in males.
- *What is the meaning of the finding?* The diagnosis of a neurocognitive disorder does not increase criminal behavior and the observed crime incidence was lower than expected.

INTRODUCTION

Life expectancy in Europe has increased in the last century,[1] and dementia is a frequent chronic disorder in the elderly. Its prevalence increases with age.[2] The estimated prevalence of dementia in people aged 60 years and over ranges from 4.6% to 8.7% depending on the region,[3] with Alzheimer's disease (AD) being the most common cause of dementia, followed by vascular dementia, Parkinson's disease dementia and dementia with Lewy bodies (LBD), and frontotemporal dementia (FTD).[4]

Neuropsychiatric symptoms, such as affective symptoms, agitation, or hallucinations, affect nearly all people with dementia at some stage of the disorder.[5] These symptoms are often associated with a wide variety of behavioral changes, including socially inappropriate or even criminal behavior.[6] Until now, scant research has been available on incidence and form of occurrence of criminal behavior in different neurocognitive disorders. Previous studies have shown criminal activity to be higher in FTD patients than in AD patients during the course of the disease.[6–9] Such behavior could be the first sign of FTD,[10] as it often emerges especially in the early stages of the disease.[8,10,11]

There is even less research focusing on the incidence and risk factors of criminal behavior after the diagnosis of a neurocognitive disorder.[12,13] A multicenter study in Japan revealed that violations of laws after initial consultation tended to decrease in the behavior variant of FTD and the semantic variant of primary progressive aphasia diagnosis groups.[9] Further, studies reporting criminal rates in different neurocognitive disorders after diagnosis compared with the general population are virtually non-existent.

Criminal activity associated with dementia is a major burden for patients, relatives, and health care services, and thus we decided to examine the differences in criminal rates between major neurocognitive disorders in an extensive national registry study. We have previously reported criminal behavior in the 4 years preceding diagnosis of a neurocognitive disorder.[11] Using the same nationwide register, we followed the criminal activity of patients after diagnosis of a neurocognitive disorder and investigated their criminal rates and differences in different types of criminal behavior in the follow-up period 1998–2015. The crime statistics in different diagnosis groups and between the sexes were compared with each other and with the same-aged general population with no neurocognitive disorders.

METHODS

Ethical Approval

The study was conducted as a register study and did not involve contacting the participants. The study protocol was approved by the Coordinating Ethics Committee of Helsinki University Hospital.

Study Design

This is a nationwide observational registry study with a data collection period between 1998 and 2015.

Study Population

The study population, i.e., all Finnish cases who received a neurocognitive diagnosis of AD, FTD, or LBD (including Lewy body dementia and Parkinson's disease dementia), was aged 40 years and over and was followed from 1998 to 2015 or until death. Death statistics were collected until the end of 2018. Mortality data were obtained from Statistics Finland, which covers all deaths of persons permanently domiciled in Finland on the day of death (*Statistics Finland, Deaths, 2021*).[14]

The total number of patients was 92,189 of whom 80,540 patients had AD (27,512 men, 53,028 women), 1059 FTD (456 men, 603 women), and 10 590 LBD (5,326 men, 5,264 women) (Table 1).

Information on Diagnosis

Data on healthcare contacts and diagnoses were received from the Finnish Care Register for Health Care maintained by the Finnish Institute for Health and Welfare. The register collects data from all public healthcare providers (hospitals, specialized outpatient services and primary care services, and home-nursing service providers) and contains different health and medical data for patients such as treatment episodes and diagnoses (*Care Register for Health Care, Finnish Institute for Health and Welfare*, 2021).[15]

Classification of diagnoses was based on the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10, 2021, World Health Organization [WHO]) that was officially introduced in Finland in 1996. The study included patients with ICD diagnosis F00 and/or G30 codes in AD, F02.0 and/or G31.0 codes in FTD. In addition, the LBD group included both F02.3 and/or G20 in Parkinson's disease dementia, and F02.8 and/or G31.8 in LBD. Cases with other types of dementia, such as vascular dementia, dementia of unknown origin or head injuries, were excluded due to their heterogenic nature.

Information on Crime

Information on crime was received during 1998 −2015 from the Finnish National Police Register, a nationwide electronic database kept by the Finnish Police Administration. Access was granted by the National Police Board of Finland.

The register includes crimes against the Finnish legislation. The police register, which includes all incidents that have come to the attention of the police of someone committing an offence,[16] yields a broad view of crime, covering more crimes than a criminal record based on convictions only.[17] The threshold for registering is low; the police must register every offence of which they become aware. The different types of crimes were classified into the following six categories: traffic, property, violence, alcohol, sexual, and other. In this study, minor delicts, such as making noise in a public area, were excluded.

Information on Crimes in the Comparison Group

Information on criminal offences in the general population was collected in a similar way as for the study group. The average number of crimes in the general population and in different age groups was extracted from the same Finnish National Police Register.[16]

The number of crimes in the study group was compared with that in the general population by calculating the standardized criminality ratio (SCR, i.e., number of actual crimes per number of expected crimes). The SCR was formed by multiplying the number of person-years in each stratum by the corresponding average crime incidence in the whole population of Finland of the same age and sex.[11]

Statistical Methods

Data are presented as means with standard deviation and as counts with percentages. Statistical comparisons between groups were done using analysis of variance (ANOVA) and Chi-squared test. The adjusted hypothesis was evaluated using generalized linear models (e.g., analysis of covariance, logistic- and Poisson regression models) with appropriate distribution and link function. Cox's regression analyses

TABLE 1. Demographic Characteristics and Incidence of Criminal Behavior in Different Neurocognitive Groups

Crimes	AD	FTD	LBD	p-Value	
				Crude	Age-Adjusted
Men					
Number	27,512	456	5 326		
Mean age at diagnosis, mean (SD)	79 (7)	69 (10)	72 (11)	<0.001 [ANOVA: $F_{2,\ 2220.4}$]	
Person-years (pyrs) followed up	79,855	1,422	17 168		
At least one crime at follow-up, n (%)	771 (2.8)	33 (7.2)	258 (4.8)	<0.001 [Pearson x^2: df = 2, x^2 = 84.8]	<0.001 [AD/LBD][a] [Wald x^2 after logit model: df = 2, x^2 = 21.7]
Total number of crimes at follow-up	1 281	47	660		
Crimes per 1,000 pyrs (95% CI)	16.0 (15.2−16.9)	33.1 (24.3 −44.0)	38.4 (35.6− 41.5)	<0.001 [Wald x^2 after Poisson model: df = 2, x^2 = 341.1]	0.27 [Wald x^2 after Poisson model: df = 2, x^2 = 2.7]
10-year survival, % (95% CI)	9.7 (9.1− 10.4)	23.1 (16.5 −30.4)	15.7 (14.2− 17.3)	<0.001 [Log-rank test: df = 2, x^2 = 36.9]	<0.001 [Wald test after Cox regression model: df = 2, x^2 = 322.8]
Women					
Number	53,028	603	5,264		
Mean age at diagnosis, mean (SD)	81 (7)	72 (10)	74 (12)	<0.001 [ANOVA: $F_{2,2859.49}$]	
Person-years followed up	185,949	1,873	20,300		
At least one crime at follow-up, n (%)	197 (0.4)	11 (2.0)	108 (2.1)	<0.001 [Pearson: df = 2, x^2 = 272.24]	0.74 [Wald x^2 after logit model: df = 2, x^2 = 0.7]
Total number of crimes at follow-up	283	17	186		
Crimes per 1,000 pyrs (95% CI)	1.5 (1.3− 1.7)	9.1 (5.3− 14.5)	9.2 (7.9− 10.6)	<0.001 [Wald x^2 after Poisson model: df = 2, x^2 = 380.6]	0.35 [Wald x^2 after Poisson model: df = 2, x^2 = 2.1]
10-year survival, % (95% CI)	15.9 (15.4− 16.5)	23.8 (16.9 −31.4)	22.3 (20.6− 24.1)	<0.001 [Log-rank test: df = 2, x^2 = 31.7]	<0.001 [Wald test after Cox regression model: df = 2, x^2 = 393.7]

AD: Alzheimer's disease; FTD: Frontotemporal dementia; LBD: Lewy body dementias (Parkinson's dementia and dementia with Lewy bodies).
[a] Hommel's multiple comparison procedure was used to correct significance levels for post hoc testing (p <0.05).

were performed to adjust mortality for confounding factors. Crude and adjusted estimates of crime incidence per 1,000 person-years were calculated using Poisson regression models with robust standard error if appropriate. Cumulative rate of crimes in the different neurocognitive groups were estimated using the Kaplan-Meier method and compared between groups with the Log-Rank test. The ratio of observed to expected number of crimes, i.e., the SCR, was calculated using a subject-years method, assuming a Poisson distribution. The numbers of observed cases and person-years at risk were calculated in 5-year age groups and separately for both genders and yearly. Probabilities of crimes in an age-, gender-, and event year-matched sample of the general population were calculated from data of the Finnish Police Register. The expected numbers of subjects for crimes combined were calculated by multiplying the number of person-years in each stratum by the corresponding crime incidence in the whole population of Finland (Official Statistics of Finland). The Poisson regression models were tested using goodness-of-fit test of the model; and the assumptions of overdispersion in the models were tested using the Lagrange multiplier test. The statistical significance of the product terms was evaluated using a Wald test. Hommel's adjustment was applied where appropriate to correct levels of significance for multiple testing (post hoc). Stata 17.0 (StataCorp LP, College Station, TX) was used for the analysis.

Diagnosis data were linked by the personal identification number assigned to every Finn. The personal identity number was linked with an ID number, and with access granted by the National Police Board we received data on criminal offending from the Finnish Police Register in a nonpersonalized format.

RESULTS

Baseline Characteristics

The mean age at diagnosis in the AD group was 79 years in men and 81 years in women, in the FTD group 69 years in men and 72 years in women, and in the LBD group 72 years in men and 74 years in women (Table 1).

Crimes in Neurocognitive Disorders After Diagnosis

In men, the proportion of patients committing at least one crime at follow-up was significantly higher in the FTD and LBD groups than in the AD group (Table 1). In men, at least one crime at follow-up was performed by 2.8% of AD, 7.2% of FTD, and 4.8% of LBD patients, showing a difference between patient groups in both crude (Pearson x^2: df = 2, x^2 = 84.8, p <0.001) and age-adjusted values (Wald x^2 after logit model: df = 2, x^2 = 21.7, p <0.001).

In women, the proportion of patients committing at least one crime at follow-up was also higher in the FTD and LBD groups than in the AD group (Table 1), and at least one crime at follow-up was performed by 0.4% of AD, by 2.0% of FTD, and by 2.1% of LBD patients. However, after age adjustment, no significant difference remained between the patient groups.

In both male and female patients, there was a difference in crimes per 1,000 person-years (95% CI) between different groups in crude comparison (p <0.001): in men, 16.0 (15.2−16.9) in the AD group, 33.1 (24.3−44.0) in the FTD group, and 38.4 (35.6−41.5) in the LBD group; in women, 1.5 (1.3−1.7) in the AD group, 9.1 (5.3−14.5) in the FTD group, and 9.2 (7.9−10.6) in the LBD group. After age adjustment, the difference was no longer significant (Wald x^2 after Poisson model: df = 2, x^2 = 2.7, p = 0.27) in men, (Wald x^2 after Poisson model: df = 2, x^2 = 2.1, p = 0.74) in women (Table 1).

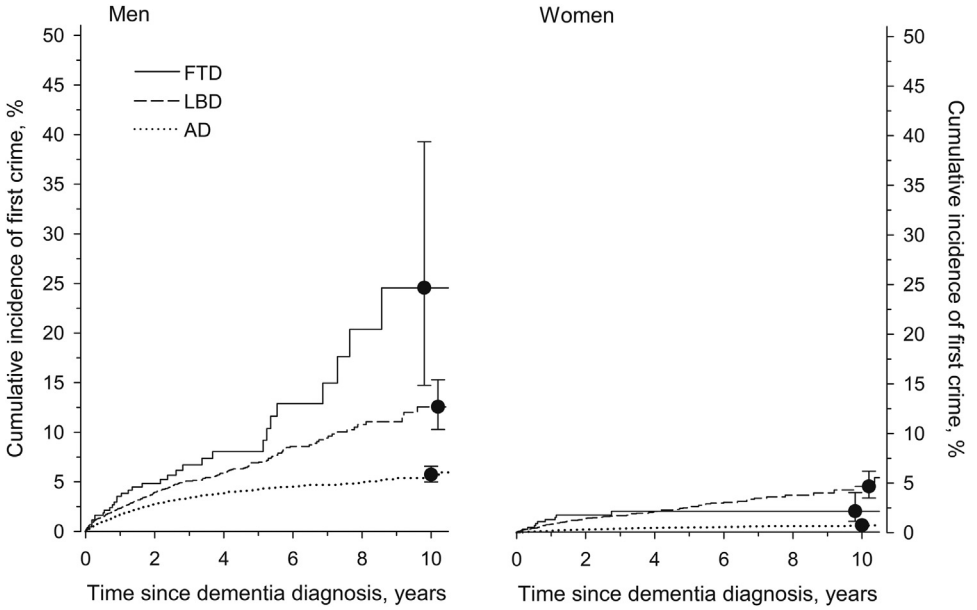
Cumulative Incidence

The cumulative incidence of first crimes in males at the 10-year follow-up since dementia diagnosis was highest in the FTD group at 24.6% (95% CI: 14.7−39.3), followed by the LBD group at 12.6% (10.3−15.3) and the AD group at 5.7% (5.0−6.6), with significant differences present between the groups. In women, the cumulative incidence was the highest in the LBD group at 4.6% (3.5−6.2), followed by the FTD group at 2.1% (1.1−4.0) and the AD group at 0.7% (0.6−0.9) (Fig. 1).

Types of Crimes

Looking at different types of crimes, the results showed that in all groups most of the crimes were

FIGURE 1. Cumulative incidence of first crimes in the different neurocognitive groups for men and women. Error bars represent 95% confidence intervals. FTD: Frontotemporal dementia; LBD: Lewy body dementias; AD: Alzheimer's disease.



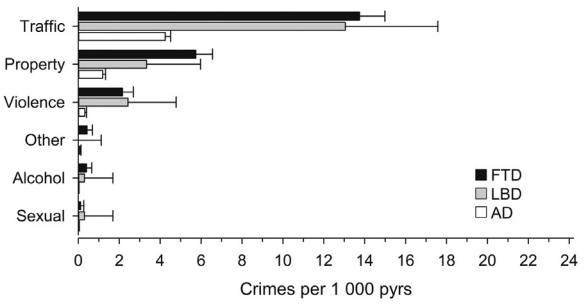
traffic-related, followed by property and violence. The numbers of alcohol-related, sexual, and other crimes were low (Fig. 2).

Comparison With the General Population

Comparing the three different groups with neurocognitive disorders (AD, FTD, and LBD) in both sexes separately, we found that the number of crimes in the study groups relative to the number of crimes in the same-aged general population was significantly lower in the different groups of neurocognitive disorders in both men and women. The only exception was in FTD women, where no significant difference between FTD women and the general population (of the same age and sex) emerged (crimes per 1,000 person-years [95% CI], Fig. 3).

The findings were similar by forming the standardized criminality ratio (SCR). The SCR (95% CI) was 0.40 (0.38−0.42) in AD men, 0.45 (0.33−0.60) in FTD men, and 0.52 (0.48−0.56) in LBD men. The corresponding ratios in women were 0.34 (0.30−0.38), 0.68 (0.39−1.09), and 0.59 (0.51−0.68).

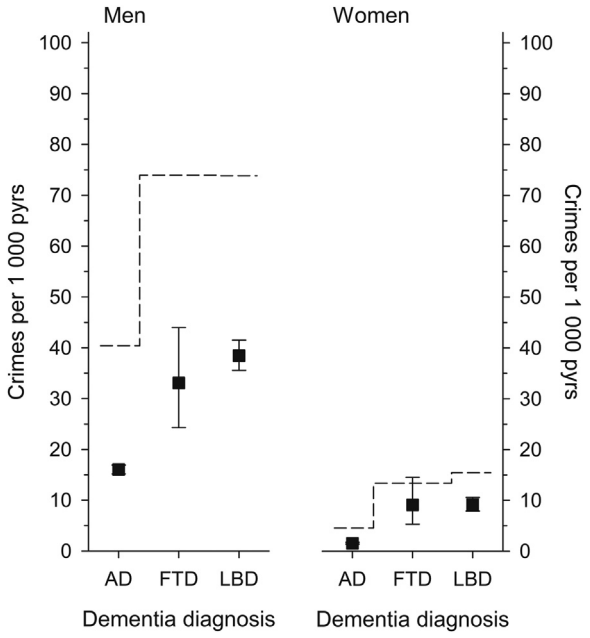
FIGURE 2. Types and incidences of crimes after the diagnosis of different neurocognitive disorders. Error bars represent 95% confidence intervals. AD: Alzheimer's disease; FTD: Frontotemporal dementia; LBD: Lewy body dementias; pyrs: person-years.



Survival

The survival rate for the entire follow-up period was higher in LBD at 7.6% (95% CI 5.7−10.0) and FTD at 6.6% (95% CI 2.5−13.5) and lower in the AD group at 1.4% (95% CI 1.1−1.8).

FIGURE 3. Age-adjusted incidences of crimes after diagnosis of a neurocognitive disorder compared with the general population according to men and women (represented by dashed lines). Whiskers represent 95% confidence intervals. AD: Alzheimer's disease; FTD: Frontotemporal dementia; LBD: Lewy body diseases; pyrs: person-years.



DISCUSSION

The observed rates of criminal acts in our study were about 50% lower in all subgroups of neurocognitive disorders, except female FTD patients, than in the general population. The observed 10-year mortality was high, which may contribute to the lower criminality rates in all neurocognitive disorders and especially in AD. Most of the crimes were committed by men, and male FTD and LBD groups committed more crimes than AD men. The cumulative rate of committing a crime was also higher in men and in the FTD and LBD groups, and the criminal activity in men persisted to some extent in the 10-year follow-up. The observed crimes were mostly related to traffic and property, and more serious crimes, such as violence or sexual crimes, were rare.

Criminal activity in the elderly population is less common than in the younger population.[18–20] Little is known about the incidence and nature of criminal behavior in different neurocognitive disorders. We found that the incidence of criminal activity was lower in patients with these disorders than in the general population (except female persons with FTD, in whom there was no difference in incidence compared with the general population). These findings could be due to different factors such as progression of neurocognitive diseases, impaired level of performance, and higher patient mortality in dementias.[21–24] The obtained diagnosis is also an indicator that the patient has entered treatment, such as medical or other treatment, and custodial care.[25–27] Medical attention may diminish criminal behavior, as has also been suggested in previous studies.[9] The crime rates in this study were higher in men than in women in the neurocognitive disorder groups. This reflects the gender distribution of criminal behavior in the general population in Finland, where the majority of those suspected and convicted of offences are men.[20]

Our study confirms already published findings[6] that criminal and socially inappropriate behavior as well as the recurrence of criminal behavior throughout the course of disease are more common in FTD patients than in AD patients. The significance of this observed difference disappeared, however, after age adjustment, except in male FTD and LBD groups, who committed more crimes than male AD patients even after age adjustment. These results may be related to the fact that patients in the AD group were significantly older. AD impairs especially cognitive and executive functioning,[26] with a downward trajectory of decline. FTD patients, in turn, commonly exhibit behavioral changes such as executive control loss and challenging or disinhibited behavior.[28,29] These behavioral changes may contribute to an increase in physical aggression and criminal or socially inappropriate behavior during the course of the disease,[6,8,10] and the criminal acts may manifest even years before dementia diagnosis.[11,28,29] Additionally, we investigated the crime rates in the LBD subgroup, which has not been done until now, and we noted that more crime occurred in the male LBD group than in the male AD group even after age adjustment.

Comparing crime incidence and crime types with previous studies is challenging due to different factors such as classification of criminal behavior, different data sources, and collection time of the data, among others. Definitions of crime and socially inappropriate or aggressive behavior have differed

between studies. In our study, the data collection was based on notifications in the police register (not medical records) as in our previous study, in which similar types of crimes emerged, with traffic offences and property crimes predominating, in the four years preceding diagnosis.[11]

Strengths of this study are the large number of cases, the long follow-up, and the comprehensive nationwide registries that present reliable criminal statistics on the general Finnish population as well as on the neurocognitive subgroups. Data include all individuals diagnosed with a neurocognitive disorder and all reported criminal activity during the follow-up period. With regard to the definition and verification of criminal offenses, as previously described, the Finnish Police Register provides a reliable and unbiased source of offences, as it is more extensive than court data and more reliable than self-reports.[16] Diagnoses of the Care Register for Health Care, which is a continuation of the Hospital Discharge Register, are considered to be reliable.[30]

However, there was no neuropathological confirmation of diagnosis, nor was exact information provided on the diagnostic protocol or on the severity of the cognitive impairment or comorbid disorders (such as other medical conditions or substance abuse) but given the number of patients this would not have been possible. The exact stages of the disease at the time of diagnosis as well as the neuropsychiatric symptoms were not known in our register study.

CONCLUSIONS

Although neurocognitive disorders are frequently associated with neuropsychiatric symptoms and even severe behavioral changes, our results suggest that crime rates in persons with a neurocognitive disorder after diagnosis were only half of those of the general population. The observed crime types were mostly minor, e.g., traffic and property crimes.

Some differences emerged between neurocognitive disorders, as criminal activity was more pronounced in the FTD and LBD groups and in males. The timing of the diagnosis, the occurrence of criminal activity, and the effects of age, interventions, medication, and entering custodial care should be investigated in more detail in the future. More research is warranted on the associations between neurocognitive symptom profiles and the risk for criminal acts.

AUTHOR CONTRIBUTIONS

MG: Conception and design, interpretation, drafting, final approval, agreement to be accountable. TT: Conception and design, interpretation, drafting, final approval, agreement to be accountable. AP: Conception and design, interpretation, drafting, final approval, agreement to be accountable. HKa: Conception and design, interpretation, acquisition, analysis, drafting, final approval, agreement to be accountable. RV: Conception and design, interpretation, drafting, final approval, agreement to be accountable. HE: Conception and design, critical revising, final approval, agreement to be accountable. JS: Conception and design, critical revising, final approval, agreement to be accountable. NL: Conception and design, interpretation, drafting, final approval, agreement to be accountable. HKo: Conception and design, interpretation, drafting, acquisition, final approval, agreement to be accountable

DISCLOSURE

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PRESENTED AT

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