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Review

Insight and Violence: An Overview of the Possible Link and Treatment Options in Forensic Psychiatric Settings

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Abstract: The belief that people suffering from psychiatric disorders are more violent, in particular psychotic patients that do not have insight into their illness, is very common in the general population. Therefore, this review aimed to present a more accurate depiction of the link between lack of insight and violent behavior, by evaluating the existing scientific literature on the topic. For this purpose, a literature search on PubMed, Embase, and Google Scholar was conducted, selecting the relevant papers published during a 20-year period (2004–2024). The paper defined insight as a multi-dimensional concept and discussed its classification, explanatory models, and clinical implications, followed by a presentation of several insight-measuring scales. The meaning of violent behavior, its prevalence, underlying mechanisms, and different measuring scales were discussed, followed by the confounding factors that influence the relationship between insight and violent behavior, treatment options for violence in forensic psychiatry settings, and methods to improve medication adherence. Contrasting results were observed regarding the impact of each factor on leading to violent acts, which suggested that the relationship between insight and violence is more complex than previously thought. In conclusion, increased attention must be paid to the investigated dimensions of both the concepts and the confounding factors, with further research required on this topic.

Keywords: violence; violent behavior; insight; schizophrenia; psychiatric patient; bipolar disorder; psychosis; forensic psychiatry; chemical restraining; medication adherence

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1. Introduction

The concept of insight was first described in the beginning of the nineteenth century when medical records first started to include observations regarding the patients' awareness about their medical conditions. At the end of the same century, the term started to reflect the awareness of mental illness and has become an important instrument in establishing the prognosis of a psychiatric disorder, in particular schizophrenia and bipolar affective disorder [1–3].

Lack of insight is a prominent feature in patients with schizophrenia, with a staggering proportion between 50% and 80% of them not believing they have a disorder. Therefore, managing the disorder becomes a challenge for both the medical team and the patients, due to decreased medication adherence, increased hospitalization rates, and hostility, which can degenerate into violent acts. According to a study conducted by Fazel et al. during a period of 15.6 years, 40% of the patients were violently offended after discharge and the mean time to violent crime was 4.2 years. Consequently, violent acts can be directed toward anyone around the patient, including medical staff. This was reflected in a study conducted by Broderick et al.; in a multihospital state psychiatric system over two years, 31.4% of the

patients committed at least one violent act, with a higher prevalence against other patients than against the medical staff [4–8].

In this regard, the impact of no insight in psychiatric patients that commit violent offences is significant, since violence in this population is a subject of forensic psychiatric expertise and the legal consequences of such acts often lead to guardianship, mandatory hospitalization, and mandatory treatment [9,10].

With this in mind, our quest on this subject began in the context of the popular belief that people suffering from mental illness, specifically psychotic disorders, present an increased risk of exhibiting violent behavior. Moreover, it is a constant debate if patients suffering from psychosis who have no or little understanding of their illness and symptoms (named poor insight) have an increased risk of violence. Starting our documentation with Amador and Davis's *Insight & Psychosis* [11], we learned that this dilemma is far from new. Arango et al. (1999) stated that poor insight is the best predictor for violent behavior. Later, Friedman et al. (2003) observed that violent patients presented more positive symptoms and less insight. At the same time, other authors, like Trauer and Sacks (2000) and Kamali et al. (2001), pointed out that there is a strong correlation between insight and violent behavior but only after exclusion of the influence of substance abuse [12–15].

However, although several studies touched on this subject, it is difficult to track consistent results because of the different definitions, scales, and protocols used. An important problem resides in the understanding and quantification of insight and in the broad definition of "violent behavior". In the present study, we aimed to clarify the concept of insight, its existing methods of assessment and clinical implications, and to present the current situation regarding aggression in the psychiatric population in order to discuss the relationship between the two, based on existing literature. We also aimed to present pharmacological and non-pharmacological interventions for violent patients in forensic psychiatry settings and possible options to increase medication adherence.

2. Material and Methods

To establish a potential relationship between lack of insight and violence, we conducted a literature search on PubMed, Embase, and Google Scholar databases using the following search terms: *violence*, *violent behavior*, *insight*, *schizophrenia*, *psychiatric patient*, *bipolar disorder*, and *psychosis*. We investigated the studies published in the last two decades (2004–2023), available in English, with participants at least 18 years old with a diagnosis of schizophrenia spectrum disorder, bipolar disorder, or first-episode psychosis, according to the DSM or ICD criteria. Studies not relevant to the topic and pediatric studies were excluded. The literature search also included manually selected references of narrative reviews, systematic reviews, and meta-analyses.

3. What Is Insight?

After the first descriptions of schizophrenia and psychosis came the questions regarding patients' understanding of their illness, and with that the first definitions of the concept, which dated from the early nineteenth century. The pioneers of this concept were Jaspers, who distinguished between awareness of illness and insight in his book *General Psychopathology* [16], and Sir Aubrey Lewis, who first provided a temporary definition of the term as "A correct attitude to morbid change in oneself" in 1934. Many other definitions have followed. Gestalt psychologists named insight "the sudden appreciation of how parts are related to an organized whole with the accompanying <<aha>> experience" (Harre and Lamb, 1983) [17].

The *New Oxford Textbook of Psychiatry*, third edition, defined insight as "a patient's capacity to understand the nature, significance, and severity of his or her illness" [18]. From an Explanatory Model perspective, insight in psychosis is the degree of congruence between patient and physician viewpoints [19].

Considering that insight is a multidimensional concept, a linear definition could not comprise all of the aspects of the term; thus, more comprehensive descriptions and classifi-

cations have been formulated. Perhaps the most well-known description is that of David from 1990 [11], which included the following: (1) the recognition of the mental illness, (2) compliance with treatment and (3) the ability to label unusual events as pathological. However, many other dimensions have been studied, with the study of Markova from 2005 being the most extensive found in our research [20]. This included nine components, as follows: (1) an attribution of the change to pathology, (2) social consequences of illness, (3) views concerning etiology and likely recurrence, (4) perception of changes in self and one's interaction with the world, (5) need for medical treatment, (6) attitudes towards experiences, (7) comparisons with previous function, (8) predictions/postdictions of performance on specific tests, and (9) resemblance of own experiences to hypothetical cases.

Researchers have traditionally divided insight into two concepts: clinical insight, defined as the awareness of a mental illness requiring treatment, and cognitive insight, defined as the ability to re-evaluate thoughts and beliefs and to resist self-certainty [21]. Cognitive insight is evaluated with regards to two sub-components: self-reflectivity, or the ability to change one's beliefs about itself, and self-certainty, meaning the confidence in being right, which implies resistance to feedback from others [22]. Metacognitive insight is a relatively new concept and was described by Spalletta et al. to be the most accurate form of one's judgement about the self. As the name "metacognitive" implies, this term refers to thinking about one's thinking, meaning the person's self-awareness of their cognitive processes or the ability to self-monitor one's changes in their state of mind and sensations [23].

Between 50–80% of people with schizophrenia spectrum disorder have no or little insight into their illness [24]. The rates are more encouraging for bipolar disorder, with 30% of patients having impaired insight [25].

4. Explanatory Models of Insight

Ever since the first depictions of this concept, researchers have struggled to determine the nature and etiology of insight. Many explanatory models have been formulated, none of them being able to fully explain the extensiveness of the subject. In their review from 2010, Chakraborty and Basu [17] synthesized the etiological models into the following: (**A**) insight as a positive symptom, considering the absence of insight a "delusion of health" [26]; (**B**) insight as a negative symptom, explained by the "mental withdrawal" from attempting to understand one's own perception of the world [27]; (**C**) insight as a disorganized symptom, associated with the formal thought disorder often seen in schizophrenia; (**D**) insight as a defense mechanism, considering that patients use denial to protect themselves against the potentially devastating realization of a own's mental illness; (**E**) lack of insight as misattribution, referring to the attribution of their symptoms to an external force (evil spirits, punishment by God, black magic, etc.) [28]; (**F**) insight as impaired metarepresentation, as patients appeared to be more able to recognize pathologic symptoms when "another person's symptoms" and not their own [29]; (**G**) individual models of insight, considering individual's values and beliefs in their understanding of the disorder; (**H**) insight as a sociocultural process, since people can have various culturally shaped frameworks to explain their illnesses, all possibly valid [30]; (**I**) the neuropsychological model, considering the loss in self-awareness and self-concern as a sign of frontal lobe damage [31]; and (**J**) the neurobiological model.

The neurobiological basis of insight was comprehensively explained by Xavier and Vorderstrasse [32] in their 2016 review. They stated that different insight types (clinical, cognitive, metacognitive) are based on different neuroanatomical sites. The first and the most studied is clinical insight, which has been found to originate from multiple brain regions, the most relevant being the prefrontal cortex, cingulate cortex, and regions of the temporal and parietal lobe (precuneus and inferior parietal lobule). Moreover, different insight dimensions have been found to be caused by different alterations in the brain. For example, poor illness awareness was associated with cortical thinness in the dorsolateral prefrontal cortex (PFC) and inferior temporal gyri; poor awareness of treatment necessity

was linked to the same structures plus the precuneus [33]. Symptoms misattribution were related to differences in cortical thickness in the orbitofrontal cortex [34]. In addition, hemisphere asymmetry, more specifically a decreased right hemisphere volume in the anterior temporal lobe, dorsolateral PFC, and parietal lobe, has been found in patients with poor clinical insight, particularly illness unawareness [35], results similar with those of neurological patients suffering from anosognosia [36]. Cognitive insight is thought to be based on two neuroanatomical formations: the hippocampus, which together with the fornix is implicated in the "self-certainty" component [37], and the medial PFC, which is essential for the "self-reflectivity" component [38]. The hippocampus (the cognitive system involved in verbal memory) has been found to be specifically involved in cognitive insight, and not in clinical insight [39]. Metacognitive insight is considered to derive from the prefrontal gray and white matter [23], but more research is required to understand this subject.

Recently, besides the traditional explanatory models of insight, a new model linking insight with empathy has been proposed by Thirioux et al. in their study [40]. They stated that insight requires two stages—recognition and acceptance of the disorder. Recognition of the mental illness is gained by taking another person's perspective and reflecting from that point of view over the own mental state. Furthermore, acceptance of illness involves empathic capacities, meaning that if a patient is able to feel and understand what another person is thinking about him/herself, separated from their own feelings about self; then, they could be able to truly accept their mental state and experiences as pathological.

5. Measurement of Insight with Scales

After dividing insight into smaller dimensions, measurement instruments that can evaluate and quantify every insight dimension were developed. There are many questionnaires that assess clinical insight into psychotic disorders. Starting from David's three-item classification of insight (awareness of mental illness, recognition of a need for treatment, and ability to re-label symptoms), they comprised multiple insight dimensions expressed in different-length questionnaires (Table 1). For example, the Birchwood Insight Scale (BIS) only covers David's insight dimensions. Others are more extensive, the largest one being the Scale to Assess Unawareness of Mental Disorders (SUMD), which comprises six general questions and four sub-scales with seventeen items each. Inspired by Amador and David's presentation of "Aspects of Insight Assessed by Different Instruments" [11], we developed a similar table with all of the clinical insight scales mentioned below (Table 2). This table summarizes what dimensions of clinical insights are represented in each of the five insight scales: the Birchwood Insight Scale, Insight and Treatment Attitude Questionnaire, Schedule for the Assessment of Insight—Expanded, Insight Scale (Markova and Berrios' second version), and Scale to Assess Unawareness of Mental Disorders. As can be seen, no insight scale depicts all insight dimensions, each of them focusing on specific aspects, and even though most aspects are presented in most scales, there are no two scales with perfect overlap. Moreover, even if all instruments evaluate present insight, only two of them (ITAQ and SUMD) are concerned with past insight and only SUMD focuses also on future insight.

While certain scales have been developed for assessing cognitive insight (Beck Cognitive Insight Scale—BCIS) or evaluating affective disorders (Insight Scale for Affective Disorders—ISAD), insight can also be assessed using general scales, such as the Present State Examination and Positive and Negative Syndrome Scale (PANSS—G12 item).

Given the topic of this paper, the question of which scale is best used for forensic settings arises. In our literature search, we found studies that evaluated forensic outpatients only by the G12 item of the PANSS scale [41] but also studies developed in forensic hospitals that administered more extensive questionnaires, such as the SUMD [42,43], SAI [44], BIS [45], or even BCIS [46]. Thus, the forensic setting does not seem to constitute an impediment in applying longer scales or for assessing cognitive insight. Specifically for the forensic population, the Eisner scale [47] was developed in 1989 to evaluate the

discharge readiness of patients. The scale analyzes "forensic insight" or the insight into legal complications of illness through three items (concern about becoming ill, relationship of illness to crime, and acceptance of responsibility for crime). However, we could identify only one study that applied this scale [48].

Table 1. Most common insight scales with each scale's number of items and definitory traits.

Name of the Scale	No. Insight Items	Type
Present State Examination (**PSE**)	1	General scale (not specific for insight)
Positive and Negative Syndrome Scale (**PANSS**)—insight item	1	
Birchwood Insight Scale (**BIS**)	8	Scales for assessing clinical insight
Schedule for the Assessment of Insight—Expanded (**SAI-E**)	11	
Insight and Treatment Attitude Questionnaire (**ITAQ**)	11	
Insight Scale (Markova and Berrios, second version, 2002) (**IS**)	30	
Scale to Assess Unawareness of Mental Disorders (**SUMD**)	74	
Beck Cognitive Insight Scale (**BCIS**)	15	Cognitive insight
Insight Scale for Affective Disorders (**ISAD**)	17	Insight in affective disorders

Table 2. Aspects of clinical insight assessed by different instruments.

Assessed Dimension of Insight	BIS	ITAQ	SAI-E	IS	SUMD
Acceptance of the illness label	X	X	X	X	X
Awareness of having a mental disorder	X		X	X	X
Perceived need for treatment	X	X	X		
Awareness of the benefits of treatment					X
Attribution of benefits to the treatment		X			X
Awareness of signs and symptoms	X		X	X	X
Attribution of signs and symptoms to having a mental disorder	X		X	X	X
Relabeling psychotic experiences correctly	X		X	X	
Awareness of the social consequences of having a mental disorder			X		X
Awareness of emotional/psychological changes			X	X	
Temporal Aspects					
Assessed present insight	X	X	X	X	X
Assessed insight for past periods		X			X
Patient's prediction for the future					X

6. Clinical Implications of Insight

Insight can affect many aspects of a patient's disease and life. Starting from the synthesis made by Chakraborty and Basu [17] in their study and after an examination of the current literature, we reached a listing of clinical implications of insight, described as follows. (**A**) Unawareness of the mental illness can increase illness severity, especially when mediated by treatment non-compliance. (**B**) Poor insight, and especially poor cognitive insight, has been linked to more severe levels of positive, negative, and disorganized symptoms, but results on the relationship between insight and psychopathology are inconsistent [49]. (**C**) Many studies reported that patients with good insight are more prone to depressed mood, a finding known as the "insight paradox". In contrast with the beneficial effects of good insight, patients can paradoxically experience another problem, namely hopelessness or demoralization, which leads to depression and even an increased risk

of suicide [50–54]. Starring et al. [55] linked this in direct association with perceived stigma, stating that patients with good insight accompanied by stigmatizing beliefs have the highest risk of experiencing low quality of life, negative self-esteem, and depressed mood. (**D**) Patients who do not believe that they are suffering from a mental illness are usually less likely to accept medical treatment for it; thus, poor insight can lead to treatment noncompliance. At the same time, non-adherence to medication can worsen psychiatric symptoms and consequently the patient's insight [49,56]. (**E**) The results regarding insight's influence on quality of life are inconsistent, with some studies reporting a better functional outcome and quality of life in patients with good insight [51], and other studies showing low quality of life mediated by increased awareness of illness [57] and self-stigma [55]. (**F**) The severity of the mental illness also affects people surrounding the patient, relatives frequently describing low levels of their own well-being [58]. (**G**) Patients with poor insight have an increased risk of being involuntarily admitted to a psychiatric emergency unit, as opposed to patients with good insight, who are more likely to present voluntarily to the emergency room and to accept psychiatric hospitalization and care [59]. (**H**) The relationship between insight and aggressive behavior will be extensively addressed below. (**I**) Impaired decision making and competence to consent have been found in a sub-group, but not in all patients with poor insight, underlying the importance of assessing this aspect at individual level [60]. (**J**) Stigma is a fundamental problem that patients with severe mental disorders face, independently of the level of insight. However, increased self-stigma can contribute to the negative effects of good insight, as stated above [55].

7. Overview of Violent Behavior

People suffering from mental illnesses, particularly from psychotic disorders, bear a high level of stigmatization from the cultural association of their disease with violent behavior. In reality, patients suffering from schizophrenia spectrum disorders have a lifetime prevalence of violence of 10% [61], in the context of a schizophrenia prevalence in the general population of roughly 0.7% [62]. Hence, the risk of violence is more an overestimation than a proven fact. However, violent behavior is indeed more present in patients suffering from schizophrenia compared to the general population, with an increased probability (1–7 times) of acting violently throughout their life. For women, the odds even rise to 4–29 times [63].

A study from 2022 by Krakowski et al. [64] claimed that violence in schizophrenia and psychosis holds a different causal pathway from the violence seen in the general population. They divided the antisocial traits associated with the psychopathology of violent behavior into two features: impairment in fear recognition and aggressive reactivity, stating that in non-psychotic violence, the two act in a complementary way, but in schizophrenia patients, they have different etiologies and represent alternative neural pathways to violence.

In another study, Rund et al. [65] suggested that violence in schizophrenia may follow at least two distinct approaches: one associated with premorbid conditions, including antisocial conduct and substance abuse, and one associated with the acute psychopathology of schizophrenia.

These differences are also seen in the victims of the violent attacks. In mentally ill patients, the aggressive behavior is often directed towards caregivers, in contrast to non-mentally ill offenders, whose victims can be strangers [66]. This high prevalence of violent acts can increase burden and stigma and decrease the well-being of family members of patients with mental disorders [67].

7.1. Neurobiology of Violent Behavior

The biological basis of aggressive behavior is complex and comprises anatomical structures, neurotransmitters (serotonin, dopamine, glutamate, gamma aminobutyric acid—GABA), hormones (orexin, oxytocin, vasopressin), genes (monoaminoxidase A—MAOA—also known as the "warrior gene" or "criminal gene", catechol-*O*-methyltransferase—COMT, opioid receptor Mu 1—OPRM1), and inflammatory markers (tumor necrosis factor alpha—TNFα and

interleukins-1, 4, 6, and 10). All brain regions are implied in this behavior, and the particular structures include the anterior cingulate cortex, prefrontal white matter, prefrontal cortex, and orbitofrontal cortex in the frontal lobe; the precuneus and angular gyrus in the parietal lobe; the superior temporal gyrus, temporoparietal junction, and temporal white matter in the temporal lobe; the cuneus in the occipital lobe; and the striatum, septum, ventral tegmental area, hippocampus, hypothalamus, and amygdala in the limbic system (Table 3) [68,69].

Table 3. Brain regions and structures involved in the mediation of aggressive behavior.

Region	Structure	Function	Reference
Frontal lobe	Anterior cingulate cortex	Part of the top-down circuitry that mediates reactive aggression.	[70]
	Prefrontal white matter	Connectivity between emotion-processing, inhibitory, and value-processing brain regions.	[71]
	Prefrontal cortex	Top-down control over subcortical regions involved in processing threatening stimuli.	[72]
	Orbitofrontal cortex	Part of the top-down circuitry that mediates reactive aggression.	[70]
Parietal lobe	Precuneus	Involved in self-consciousness and self-referential processes.	[73]
	Angular gyrus	Part of the brain networks underlying moral reasoning; anger expression facilitating projections with limbic structures.	[74]
Temporal lobe	Superior temporal gyrus	Language and speech processing; alterations observed during parental verbal abuse.	[75]
	Temporoparietal junction	Part of the structures important for moral behavior.	[76]
	Temporal white matter	Connectivity in the frontotemporal, limbic, and paralimbic brain regions.	[77]
Occipital lobe	Cuneus	Motivational attention—perceptual processing of motivationally relevant stimuli (e.g., proximity).	[78]
Limbic system	Striatum	Reward processing. Activation of ventral striatum has been observed in desires of revenge.	[79]
	Septum	The lateral septum influences the activities of attack-related cells in the medial hypothalamus.	[80]
	Ventral tegmental area	Promotes aggression and establishes baseline aggression through dopaminergic neurons projecting to the lateral septum.	[81]
	Hippocampus	The dorsal hippocampus is involved in spatial memory. The ventral hippocampus is involved in emotions, motivation, and defensive behavior regulation.	[82]
	Hypothalamus	Controls homeostasis and motivated behaviors.	[83]
	Amygdala	Processing threatening stimuli; autonomic, neuroendocrine, and behavioral response mediation.	[83]

Zooming in on the neurotransmissions implied in aggressive behavior, several serotonin (5-HT), dopamine (D), GABA, and glutamate receptors, as well as the dopamine transporter (DAT), can predispose people to aggressiveness. Data in the literature and evidence regarding serotonin neurotransmission state that the activation of 5-HT_{2A} and 5-HT_3 receptors was associated with increased aggressive behavior [84]. Data about the dopamine neurotransmission correlate the aggressive behavior with a DAT blockade and a lower

density of type 2-dopamine receptors (D_2, D_3, and D_4) in caudate and putamen [85–87]. Inhibition of the $GABA_A$ receptor activity, especially in the anterior cingulate cortex, AMPA Glu3 receptor (AMPA—α-amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid, Glu—glutamate) dysfunction, and inhibition of *N*-methyl-*D*-aspartate (NMDA) receptors with low-dose antagonists have all been linked to aggressive behavior [70,88–91]. Several substances have been known to precipitate or reduce aggressiveness, based on their affinity for these receptors and transporters.

7.2. Drug-Induced Violent Behavior

7.2.1. Anabolic Androgenic Steroids (AASs)

AASs are commonly used to enhance the physical performance of athletes, to rapidly increase muscular mass and strength, and for doping purposes in various sports competitions. The administered equivalent doses for performance-enhancing purposes are 250–5000 mg/week, which are considered supraphysiological doses, exceeding by 5–100 times the natural production of testosterone in men. Chronic use of AASs has been associated with somatic adverse effects such as acne, gynecomastia, and potency problems, and more frequently with psychiatric adverse effects, including aggressiveness, anxiety, and sleeping and mood disorders [92,93].

Aggression and violence account for the highest prevalence of adverse effects in high-dose AAS users. AASs can easily pass through the brain–blood barrier (BBB) and several mechanisms have been proposed, including the interaction with the androgenic receptors in the central nervous system (CNS) and modifications in the serotonergic, dopaminergic, and glutamatergic pathways. It has been suggested that AASs enhance the activation of D_2 receptors from supraoptic neurons onto hypothalamus, stimulate 5-HT_{2A} receptors in hypothalamus, and increase the excitatory neurotransmission following the induction of NMDA receptor phosphorylation [93,94].

Forensically, it has been shown that chronic AAS users have a nine times greater risk of being convicted of a crime compared to the general population, according to a study published by Christoffersen et al. in 2019 [95].

7.2.2. Alcohol

Strong evidence correlates abusive alcohol intake with an increase in violence and aggressive behavior, with consequences for both the drinker and their victims due to sustained injuries. The risk is further increased if psychiatric comorbidities or other substances are associated [68,96].

The mechanisms of alcohol-induced violence include the inhibition of PFC and stimulation of dopamine release in striatum, in acute alcohol intake, and serotonin neurotransmission impairment in PFC and amygdala in chronic alcohol intake [97].

Forensically, reports in Europe estimated that out of all public violent incidents, 50% were linked to alcohol in the United Kingdom and between 26% and 43% in Germany, Austria, and the Netherlands. Moreover, out of all alcohol-related incidents, 80% of them were related to nightlife. In the United States, it was more likely for women than men to suffer the consequences of alcohol use by a partner or family member, while more men were reported driving under the influence of alcohol [98,99].

7.2.3. Cannabis

Chronic use of cannabis and withdrawal have been associated with an increased risk of altered mental health and behavioral issues, including aggressiveness and increased impulsivity. Several factors can predispose cannabis users to aggressivity, including environmental and genetic predispositions and differences between sexes and genders. Moreover, the endocannabinoid system takes part in the modulation of aggressiveness through the CB_1 receptors, which are abundant in GABAergic and glutamatergic neurons and modulate the release of their neurotransmitters, which have been previously shown to be part of the neurobiology of aggressivity [100,101].

Following the legalization of recreational cannabis use in some countries, there has been an increase in domestic violence cases. For example, in the United States, cities like Denver and Aurora experienced an increase of 48.2% in domestic violence cases. However, this observation is not generally valid. For example, in Canada, following legalization in 2018, the cannabis-related criminalization rate among adults decreased [102,103].

7.2.4. Stimulants

Stimulant drugs include all categories of substances used in pharmacological neuroenhancement, whether they are over-the-counter (OTC) drugs (methylxanthines, pseudoephedrine, herbal medicines, vitamin supplements, and homeopathic preparations), prescription substances (modafinil, methylphenidate, amphetamine, methamphetamine), or illegal substances (amphetamines, cocaine, cathinones, MDMA—3,4-methylenedioxymethamphetamine etc.) [104].

Methamphetamine and amphetamine may increase aggressivity and violent behavior; however, the link between them is unclear. While their mechanism is based on the increased release of dopamine, norepinephrine, and serotonin, all of which modulate the neurobiology of aggression, a systematic review published by O'Malley et al. concluded that acute administration of methamphetamine or amphetamine did not increased the risk of aggressive behavior [105]. However, concomitant use with alcohol has been demonstrated to increase aggressivity, mainly due to alcohol, which is demonstrated to enhance impulsivity and violence [106].

7.2.5. Hallucinogens and Empathogens

Hallucinogens or classical psychedelics act as agonists of the 5-HT_{2A} receptor, inducing an experience characterized by ego dissolution and a sense of invincibility, which can facilitate aggressiveness in users. On the other hand, MDMA, an empathogen, acts directly on the monoamine neurotransmitters and modifies blood flow in brain regions that regulate fear-based behaviors. The latest literature evidence suggests mixed results regarding the link between hallucinogens, MDMA, and aggression [107].

7.2.6. NMDA Receptor Antagonists

Antagonists used for recreational purposes, such as phencyclidine or 3-methoxyphencyclidine, can cause aggression through their psychosis-inducing effects. Similarly, high doses of dextromethorphan, a weak NMDA receptor antagonist, can induce psychosis and hence increase the risk of aggressivity [108,109].

7.2.7. Heroin

Heroin and other opioids can facilitate aggressive behavior through the behavioral changes that they can induce during use and the withdrawal syndrome. During drug use, increased levels of dopamine are released, resulting in intensive craving and addictive behavior [110].

According to a study conducted by Maremmani et al., eight out of every ten patients with heroin use disorder displayed aggressive behavior, 23.8% of which showed verbal hostility, irritability, negativism, and indirect hostility, while the other 76.2% showed suspicion, resentment, assault, and guilt [111].

7.2.8. Anticonvulsants

Levetiracetam, perampanel, topiramate, brivaracetam, tiagabine, vigabatrin, and zonisamide have been associated with an increased risk of aggressive behavior compared to other anticonvulsant drugs. A proper pharmacological mechanism of action could not be ruled out, but based on several observations, the induced aggressiveness may be caused by the inhibition of the AMPA receptor and alterations in serotonin and GABA levels. A relief in the aggressive behavior has been observed when switching from levetiracetam to brivaracetam, representing a potential option in clinical practice [112–114].

The relation to insight, possible mechanisms related to aggression and violence, and psychiatric symptoms of the aforementioned drugs are summarized in Table 4.

Table 4. Summary of the drugs possibly associated with increased aggressive and violent behavior.

Substance	Relation to Insight	Mechanism	Psychiatric Symptoms	References
AASs	Associated with poor judgement	Enhance the activation of D_2 receptors from supraoptic neurons onto hypothalamus; stimulate 5-HT_{2A} receptors in hypothalamus; increase excitatory neurotransmission.	Aggressiveness, anxiety, sleeping disorders, mood disorders	[92–94,115,116]
Alcohol	Impairs judgement and insight	Acute intake—inhibition of PFC and stimulation of dopamine release in striatum; chronic intake—impairment of serotonin neurotransmission in PFC and amygdala.	Aggressiveness, temporary anterograde amnesia, sleeping disorders	[97,117]
Cannabis	Impairs insight	Modulation of CB_1 receptors in GABAergic and glutamatergic neurons; modulation of GABA and glutamate release.	Psychosis, schizophrenia, depression, anxiety	[100,101,118,119]
Stimulants	Impairs insight	Enhance release of dopamine, norepinephrine, and serotonin.	Psychosis, schizophrenia, anxiety, insomnia	[119,120]
Hallucinogens and empathogens	Capable of inducing false insights	Agonists of 5-HT_{2A} receptors.	Perceptual effects, depersonalization, distortions, illusions, perceptual intensifications, hallucinations	[121,122]
NMDA receptor antagonists	No available data	Antagonize the NMDA receptors.	Psychosis, schizophrenia, catatonia	[108,109,123]
Heroin	Impairs insight	Opioid agonist.	Addiction	[110,124]
Anticonvulsants	No available data	Inhibition of AMPA receptors and alterations in serotonin and GABA levels.	Aggressiveness, irritability, anger, insomnia, mood swings, suicidal behavior	[112–114]

8. Measurement of Violence with Scales

There are several violence risk questionnaires, each targeting particular features or subject groups. A list of such questionnaires along with their corresponding extent and form of rating is presented in Table 5.

Numerous scales evaluate patients solely through observation during interviews, considering various aspects, illustrated in Table 6. These scales are usually used to assess the violence risk of patients admitted into a psychiatric unit. At the end, it results in a final score which corresponds to the violence risk or, in the case of the NOIIS scale, a graph similar to a temperature scale [125].

Other scales are based on both psychiatric interviews and information from patients' clinical files, including demographic information regarding childhood and educational trajectory. The HCR-20 is one of the most used scales in studies evaluating violence among psychiatric patients. It consists of ten historical, five clinical, and five risk-management items and can be applied in both clinical and forensic settings [126]. The START tool is a more exhaustive instrument that explores a patient's strength and vulnerabilities related to 20 factors, developing 7 risk estimates (violence, self-harm, suicide, unauthorized leave, substance abuse, self-neglect, and being victimized) [127]. The VRAG-R, PCR, VRS-2, and SAQ are more often used in forensic settings. The VRAG-R uses clinical records to assess the patients' risk of violence recidivism and is suitable for male patients who have committed serious violent or sexual offenses [128]. The PCR uses interviews and information from the patient's file record to appraise the patient's level of psychopathy [129]. It is composed of questions addressing emotional detachment and antisocial behavior. The VRS-2 consists of

6 static factors regarding the patient's upbringing and past offenses and 20 dynamic factors, assessed through interview, noting the stage of change in each domain. It can be used to monitor variations in risk and motivation to change, especially for forensic psychiatric patients which are considered for community access [130]. The SAQ is the most different from the others by virtue of being (as the name implies) a self-administered test. The items are classified into eight subscales: criminal tendencies, antisocial personality problems, antisocial personality disorder, conduct problems, criminal history, alcohol/drug abuse and antisocial associations, anger, and a final validity item, the last two not taking part in the total score. It is used for both assessing violence risk and recidivism and assignment to a suitable treatment program [131].

Table 5. Summary of the violence risk scales.

Name of the Scale	No. Items	Score/Item	Rating
Broset Violence Checklist (**BVC**)	6	0 → 1	0—low risk 1–2—moderate risk >2—increased risk
Dynamic Appraisal for Situational Aggression (**DASA**)	7	0 → 1	0—low risk 2–3—moderate risk >4—increased risk
Modified Overt Aggression Scale (**MOAS**)	4	0 → 4	Higher score → increased risk
Nursing Observed Illness Intensity Score (**NOISS**)	5	As a "temperature scale"	
Historical, Clinical, and Risk Management 20 (**HCR-20**)	20	0 → 3	Higher score → increased risk
Short-Term Assessment of Risk and Treatability (**START**)	20	0 → 2 on strength/vulnerability	7 risk estimates (low/moderate/severe)
Violence Risk Appraisal Guide—Revised (**VRAG-R**)	12	−7 → +6 (depends on item)	Higher score → increased risk
Violence Risk Scale Second Version (**VRS-2**)	26	0 → 3	Higher score → increased risk
The Psychopathy Checklist Revised (**PCR-R**)	20	0 → 2	Cut-off: 30 in US; 25 in UK
Self-Appraisal Questionnaire (**SAQ**)	72	True/False	Higher score → increased risk

Table 6. Aspects assessed by interview—observation scales.

Investigated Aspect	BVC	DASA	MOAS	NOIIS
Irritability/easily angered when requests are denied	X	X		
Agitation	X			X
Distress				X
Confusion	X			
Apathy/withdrawal/negative attitudes		X		X
Sensitivity to perceived provocation		X		
Unwillingness to follow directions		X		
Cognitive accessibility				X
Conflict				X
Impulsivity		X		
Verbal threats/aggression	X		X	
Physical threats/aggression	X		X	
Self-aggression			X	
Aggression towards subjects	X		X	

Finally, a unique violence risk assessment tool is the Classification of Violence Risk (COVR), which is an interactive software program designed to estimate the risk of a person hospitalized for a mental disorder to be violent to others. After a chart review and a

brief interview with the patient, the software generates an estimation of the violence risk, ranging from 1% to 76% [132].

9. The Relationship Between Insight and Violent Behavior: The Influence of Confounders

There is no settled answer for the question "Is insight an actual risk factor for violent behavior in psychosis?" In their review from 2019, Smith et al. [133] reported that among 18 studies published between 1980 and 2019, only 8 demonstrated a positive relationship between poor insight and violence. They also described the limitations of each study, proving that consistent, reliable results are difficult to obtain. Among these limitations, we mention small sample sizes, the retrospective design of the study, inappropriate scales for assessing insight dimensions, heterogenous definitions for violent behavior, not differentiating between past and present insight, and not excluding the impact of confounding factors, like positive symptoms, psychopathy, and substance abuse.

A study from 2018 by Schandrin et al. [134] with 666 patients with schizophrenia from 10 tertiary centers and using three insight instruments (SUMD, BIS, and PANSS G12 item) stated that specific insight dimensions were linked to specific sub-types of aggressive behavior. They described aggressivity as a multi-dimensional approach, considering an emotional component (anger) and a cognitive component (hostility). They found that hostility increased with insight, but this relationship faded when controlling for the potential confounding effect of depression (often associated with increased insight). A possible underlying mechanism could be that high insight increases self-stigma, which increases depression and could also lead to the expression of an underlying hostile tendency (trait). Furthermore, insight into the consequences of illness, especially partial or unstable insight, was associated with the more impulsive and reactional dimensions of aggressiveness, namely anger and physical aggressiveness.

A recent study from 2023 by Fischer-Vieler et al. [135] compared patients with a diagnosis of a psychotic disorder with patients without known psychiatric conditions, assessing insight with the BIS and PANSS G12 tools, and stated that a history of violence was significantly associated with lower insight, even after controlling the confounders. However, they did not take into account the possible confounder effect of psychopathy. In addition, the assessed violent events had taken place, in some cases, long before the moment of insight assessment. A study from the same year analyzed the influence of cognitive insight and functional remission on criminal behavior in schizophrenia and concluded that with an increase in symptoms' severity came a decrease in a patient's insight and functional remission, with a tendency towards criminal behavior [136].

A narrative review from 2015 by Lamsma and Harte [137] on 69 studies between 1990 and 2013 noted that the relationship between psychosis and violence is more intricate than initially thought and proposed a diagram of 41 possible interrelated pathways, binding insight to violence both directly and indirectly, mediated by treatment non-adherence.

Regarding bipolar disorder in particular, the available literature is scarce. In a study from 2010 by González-Ortega et al. [138], the authors concluded that aggressive behavior during acute manic episodes was linked to positive symptoms, involuntary admissions, and lack of insight, but they quantified insight only through the G12 item of PANSS. A more recent study from 2019 by Luo et al. [139] found that poor insight, measured by the ITAQ, was associated with increased rates of involuntary admission. A study from 2017 by Pompili et al. [140] noted that aggressive behavior occurred mainly in manic episodes but when comparing euthymic patients with healthy controls, the violence rates were higher in the euthymic group. A study conducted by Asgarabad et al. in 2022 found out that the awareness of the disorder in schizophrenia was more impaired compared to bipolar affective disorder, but that similar levels were observed for the awareness of medication effects, social consequences, and clinical insight [141]. There is scarce information regarding the differences in traits of aggression and violence between bipolar affective disorder and schizophrenia, with some authors claiming an increased risk of violence in bipolar disorder, especially during manic episodes [142].

As expected, insight is one of the many factors having an impact on a patient's tendency towards violent behavior. Numerous studies from the last two decades have focused on the risk factors for violence, dividing them into static and dynamic. Static risk factors, present in the HCR-20 v3 as historical risk factors, include criminal histories [143] such as previous violence [144–146]; childhood misconduct [147,148]; prior convictions; substance [65,143,145,147–150] and alcohol abuse [143,146]; comorbid psychiatric diagnoses, especially psychopathy [65,144] and other personality disorders [151]; and poverty and social disadvantages [147,152,153]. In contrast, dynamic risk factors, found in the HCR-20v3 under clinical risk factors, comprise the following: positive symptoms, non-adherence to treatment [143,154,155], poor insight [48,65,133,144], and impulsivity [65,126]. Negative symptoms, such as social withdrawal and blunt affect, have been found to hold a protective role for violence [147,148].

In their review, Steinert et al. [156] stated that clinical and psychopathological variables are more predictive for inpatient violence, while static risk factors are more applicable to community violence.

Nevertheless, not all of the factors mentioned above contribute equally to the risk of violent behavior. The level of impact of each factor related to violent behavior is, to some degree, particular to each paper that studied it. In their review of 110 studies, Witt et al. [143] divided the factors into strong, moderate, or weak associations with violent behavior in psychosis. A strong association was found in the case of a history of violent acts, non-adherence with psychological treatments, substance use disorder, positive symptoms, lack of insight, and poor impulse control. Non-adherence to medication and comorbid antisocial personality disorder were found to be moderately associated with violence. A more detailed illustration of the findings from the review is represented in Figure 1. Somewhat controversial results were presented by a review from 2018, which found that lack of insight had a more severe effect on violence than positive symptoms, naming insight "the only single variant that could predict violent behavior" [65]. Although intriguing, the results of the studies included were mixed and the other important confounders must be taken into consideration.

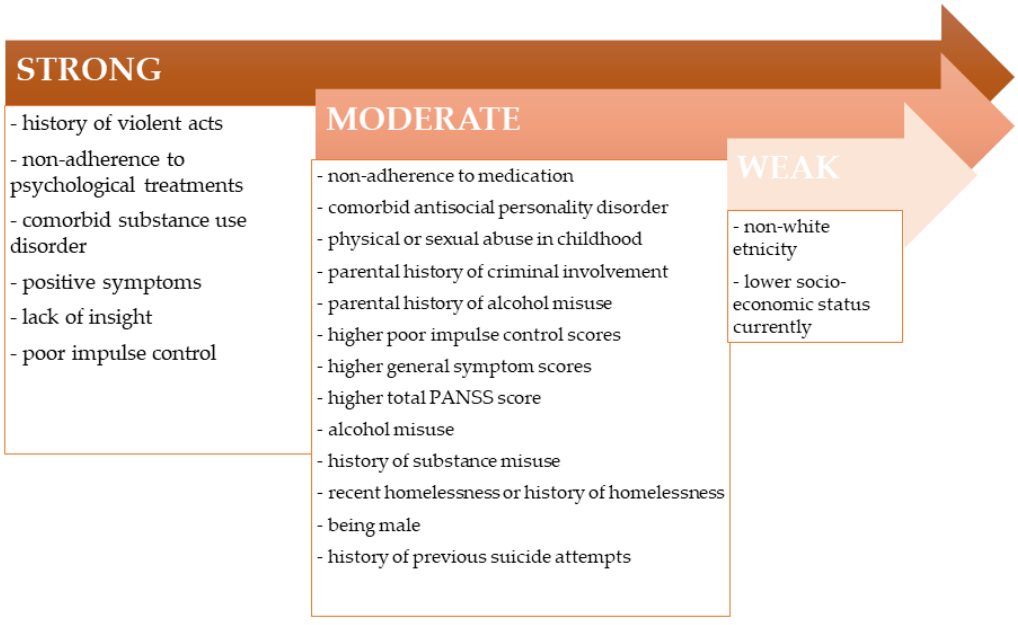

Figure 1. Classification of the levels of association of different factors with violent behavior (from the findings presented by Witt et al. [143]).

The relationship between insight and violence is at least partly mediated by two important factors: positive symptoms and treatment non-adherence. With regard to positive symptoms, an important mention would be that, although patients with poor insight often exhibit severe positive symptoms, as demonstrated by other studies [157,158], better

insight scores were seen in patients only with hallucinations compared to patients only with delusions. As Galletti et al. explained, hallucinations represent a greater breaking experience from the outside world, which is easier for the patient to recognize as not real [159]. As discussed by Lincoln et al. in their review, the relationship between insight and symptoms' severity over time is complex and worth more research [133]. Furthermore, low insight was associated in many studies with poor compliance with pharmacological and psychosocial therapies [42,133,160–162].

A very important risk factor for violence, often seen as a comorbidity in patients with psychotic disorders, is represented by alcohol and substance abuse. A study from 2008 by Rueve and Welton [66] that discussed the problem of violence in mental illness mentioned that patients with alcohol and drug use had more arrests over their lifetime than patients with schizophrenia, personality disorders, or affective disorders. They also noted that patients suffering from both substance use disorders and personality disorders were 240% more likely to commit violent acts than mentally ill patients without substance abuse comorbidity, although the sources cited were too outdated to be taken without a doubt. Lamsma et al. [137] named substance abuse a major predictor for violence in psychosis and suggested four possible mechanisms by which substance use could increase the risk for violence: (a) through their neurobiological effects, by reducing inhibitions; (b) by having a detrimental effect on a patient's social support system; (c) via the buying and selling of illegal drugs, which often take place in criminogenic environments; (d) by aggravating psychotic symptoms. The study from 2018 by Rund et al. [65] named comorbid substance abuse in schizophrenia "the most severe form of violence", although not all studies agree on this. Other papers found that recent alcohol and drug misuse were significant risk factors for both severe and less severe violence [143]. In general, studies agree that substance use disorders lead to a significant increase in the risk of violence, but that is not a homogeneous finding and there is an urgent need for fresh data on this subject.

When addressing the influence of a patient's history on the risk of violence, Witt et al. [143] found that criminal history factors, such as previous violent acts and prior arrests, were more strongly associated with violence than substance misuse and demographic factors, but other studies presented conflicting results.

Finally, stressful situations and events can also increase the risk of violence, as described by many studies in the context of the COVID-19 pandemic, when social isolation, economic strain, childcare stress, and virus-related fears led to a higher number of violent acts. As mentioned by Whiteman et al., the most affected population consisted of people who already did not live in a safe environment previous to the pandemic, the most frequent victims being women, children, and elderly people [163,164].

10. Does Diagnosis Matter?

There remains the question of how this relationship is influenced by the diagnosis. We know that bipolar disorder bears a better prognosis than schizophrenia, but do patients with schizophrenia present more severe violent behavior compared to patients with comparable levels of insight but with a diagnosis of bipolar disorder? And can we compare insight into two separate illnesses?

Research that could give an answer to these questions was difficult to find. When addressing the comparison between diagnoses, studies usually focus only on insight or only on violent behavior. Regarding insight, the results were mixed. Some studies described poorer insight in schizophrenia [165], but this could become non-significant when adjusting for age [166]. Others observed lower insight in schizophrenia but only in specific dimensions, such as the need for treatment and presence/outcome of illness, as described in a study from 2019 by Huang and Chang [167], or symptom re-labeling, as illustrated by a paper from 2007 by Varga et al. [168], which also suggested that differences in general insight (in illness awareness) could be better explained by symptom severity and deficits in working memory function than by the specific diagnosis.

With respect to violent behavior, research was even more lackluster. A paper from 2014 by Robertson et al. showed that patients with bipolar disorder, especially with comorbid substance abuse, had an increased risk of violent behavior than patients with schizophrenia, especially when not associated with substance abuse [169]. Although intriguing, substance abuse is known to be an important independent risk factor for violent outbursts and more research on this subject is required before reaching a firm conclusion.

11. Limitations of Studies Assessing Insight/Violence

There are not many available studies assessing the relationship between insight and violence, especially in recent years. After analyzing the existing literature, which comprised heterogenous study protocols and, consequently, contrasting results, we wanted to point out a few important aspects to bear in mind when designing a study on this subject. Inspired by the review by Smith et al. [133] and several other reviews and meta-analyses [63,65,137,143], we gathered a list of identified limitations. These can be classified into the following: (**1**) factors regarding study design, namely small sample size and retrospective design; (**2**) factors regarding insight—inappropriate scales for assessing the insight dimensions and the lack of differentiation between past, present, and future insight, leading to false conclusions when comparing a past offense with a patient's present insight; (**3**) factors regarding violent behavior—heterogenous definitions for violence, distinct reports of violent behavior (by the patient, by family, by law enforcement, or by medical staff); (**4**) factors regarding the psychiatric diagnosis—different results in different psychotic conditions and insufficient data concerning bipolar disorder; (**5**) the importance of excluding confounders; (**6**) patients' drop-out.

12. Treatment Options in Forensic Psychiatric Settings

According to a systematic review conducted by Howner et al., knowledge regarding pharmacological treatment in forensic psychiatry settings is limited. Therefore, targeting the receptors that mediate aggressive behavior and violence represents the most rational treatment choice in patients displaying these characteristics. Parenterally administered antipsychotics represent the most frequently used drugs for the chemical restraint of aggressive patients, with haloperidol being the most used agent out of all antipsychotics. Their efficacy in the management of these situations is due to their antagonist activity on the 5-HT_{2A} (atypical antipsychotics) and the D_2 (typical antipsychotics) receptors. Other commonly used chemical restraint options reported in the literature were parenterally administered benzodiazepines and intravenous (i.v.) sodium valproate. Several studies on animal models have demonstrated that setrons, which are antagonists of the 5-HT_3 receptor, can also reduce aggressivity [84,170,171].

Since the MAOA gene is referred to as the "warrior gene" or "criminal gene", the potential of monoamine oxidase inhibitors (MAOIs) to reduce aggressive behavior have been taken into consideration. However, animal studies have shown that MAOIs have different influences depending on the developmental stage, selectivity on A or B types, and dosages [69].

As previously stated, high doses of NMDA antagonists can reduce aggressive behavior. Examples from the literature include a 4–5 mg/kg intramuscular ketamine single dose or 20 mg/day of memantine [172].

Besides pharmacological treatment, there have been described several non-pharmacological interventions in forensic psychiatry settings, including neurocognitive training, cognitive–behavioral treatment programs like Reasoning and Rehabilitation (R&R), Effect of Life Minus Violence—Enhanced, Positive Behavioral Support (PBS), the therapeutic theater project, and mindful yoga [173].

Before applying chemical restraining methods, it is advisable to use de-escalation techniques meant to recognize early signs of anger in patients and to bring them into a calmer state. These techniques are composed of both verbal communication (e.g., negotiation,

tactful language, calm tone, etc.) and non-verbal communication skills, like posture, body language, active listening, or an empathetic attitude [174–176].

13. How to Increase Medication Adherence?

As previously stated, reduced medication adherence represents one of the main causes for lack of insight and an increasing risk of violence [56]. According to Velligan et al., non-adherence contributed to the lack of insight in 55.6% of the studies (20 out of 36) taken into consideration, exceeding other causes such as substance abuse, medication-related side effects, and cognitive impairment [177]. Other statistics suggest that medication non-adherence is as high as 63–74% in patients with schizophrenia and 50% in patients with bipolar affective disorder [178].

The main cause of non-adherence was a negative attitude towards medication, which can be fueled by factors like hostility and uncooperativeness at first admission, lack of information regarding the treatment, the cost of and access to treatment, stigma, effectiveness, possible side effects, complexity of regimens and possible risk of drug–drug interactions, doses, formulation, and the belief of some patients that treatment is no longer necessary when they sense a good response to treatment in the early phases [177,179,180].

Several interventions can be used in order to increase treatment compliance. These strategies can be either addressed to the patient or to the medication they are taking. Patient-directed interventions include psychoeducational programs (group therapy and meetings, in which the family can be encouraged to participate), individualized interventions, motivational approaches, behavioral strategies, family support, and the establishment of a strong therapeutic alliance. Treatment-directed interventions aim to improve efficacy, safety, and adherence. The improvement of efficacy includes dose adjustments and the selection of the best choice of treatment, given the clinical evidence and past experiences, while safety is achieved by proper management of the adverse effects and drug–drug interactions [180].

Adherence can be tracked through traditional pill counting or using electronic medication monitoring systems that can record each time the bottle is opened. However, none of these methods can rule out if the pills are taken out and discarded without ingestion. Therefore, novel technologies such as ingestible sensor use can be employed. An example of such approved technology is Abilify® MyCite (aripiprazole), which tracks if the pill has been ingested through a wearable patch and a smartphone application. Data in the literature evidenced an increased adherence of between 73.9% and 88.6% in patients with schizophrenia, bipolar affective disorder, and major depressive disorder. Disadvantages of using ingestible sensors include a decreasing need for communication between the patient and the healthcare professional, which can weaken the therapeutic alliance, increased costs, potential inadequate usage for patients with surveillance paranoia, and even ethical concerns, such as restriction of the patient's autonomy [180–184].

The acceptance of long-acting injectable (LAI) antipsychotics can be improved using shared decision making, by presenting the necessary information to the patient in a simple and clear manner, and by listening to their preferences, fears, and/or past negative experiences regarding LAI antipsychotics. The healthcare professional must reassure the patient regarding the benefits of LAI, namely the better efficacy compared to oral treatment in the prevention of relapses and the better overall outcome if initiated during the early phases of the illness. There is an increased chance of improving treatment adherence if the patient's involvement in the choice of therapy is accompanied by constant communication and the work of comparison with the medical staff [185].

14. Conclusions

In this review, we wanted to present the complex relationship between insight into psychiatric illness and violent behavior. For this purpose, we described the concept of insight and its origins, dimensions, explanatory models, measuring scales, and implications. One of the implications of impaired insight was seen to be an increased risk of violent behavior. However, there are many factors that can lead to increased aggressivity, starting from a

genetic predisposition and the psychotropic effects of medication and other substances, but also including demographic and clinical factors specific to each patient. Both insight and violent behavior can be assessed through several questionnaires, each of them with their features and indications.

There is a continuous debate in the literature regarding what clinical factors influence the most violent behavior. Positive symptoms, non-adherence to medication treatments, substance and alcohol abuse, and a history of aggressive behavior and personality disorders are only a few that enhance the chance of a patient without insight into their illness acting in a violent manner. On the other hand, negative symptoms and depression have been found to provide a protective role against violent behavior. Therefore, in clinical practice, it is important to be aware of and reduce the impact of any factor that may contribute to the lack of insight of a patient and predispose them to violence.

Several interventions like motivational interviews, medication reconciliation, or various psychoeducational programs should be applied for a better therapeutic alliance, while chemical restraint should be reserved only for emergencies, when no de-escalation is possible.

For reliable research on the relationship between insight and violent behavior, the definitions and extensive classifications of insight and violence must be understood, while proper measuring scales for the specific investigated dimensions must be used.

Finally, because of the many controversial results on this topic, more comprehensive and updated research is required.

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